EBI Consulting
environmental | engineering | due diligence

21 B Street
Burlington, MA, 01803
Tel: (857) 205-4165

FIRE SAFETY ANALYSIS REPORT

Property Identification:

Liquid Propane Gas Transfer Facility
42 Westboro Road
Grafton, MA 01536

EBI Project No. 68150018

June 17, 2015

Prepared for:

Grafton and Upton Railroad
42 Westboro Road
Grafton, MA 01536

Prepared by:

EBI Consultants
21 B Street
Burlington, MA 01803
857-205-4165

Dr. Robert S. Palermo, PE, LSP, CSP, CET, RPIH
Principal Engineer/Safety Professional

TABLE OF CONTENTS

FIGURES:

TABLES:

APPENDIXES:

1.0 INTRODUCTION

EBI Consultants (EBI) has prepared this Fire Safety Analysis Report (FSAR) to update the Fire Safety Analysis (FSA) previously prepared by The Godfrey Group in December of 2012. Since that time, The Grafton and Upton Railroad (G&UR) has designed and partially constructed a Liquid Propane Gas Transfer Facility (LPGTF) at their property located at 42 Westboro Road in Grafton, Massachusetts. This FSAR discusses fire safety requirements, facility specific information, applicable guidance, codes and standards to which the LPGTF was designed and constructed, how the LPGTF will be operated and the procedures to be followed in the event of an emergency. The LPGTF has been designed and will be operated in full conformance with NFPA 58 – Liquefied Petroleum Gas Code, 2011 Edition requirements. Additionally, guidance documents adopted by the Petroleum Education Research Council (PERC) and the National Propane Gas Association (NPGA) for the training of operators and for plant operation and maintenance (O&M) have been incorporated into the OSHA Process Safety Management (PSM) Plan prepared for the LPGTF. Recommendations are also provided for additional work to be undertaken to achieve compliance with the noted guidance, codes and fire protection regulations.

A meeting was held at the Grafton, MA Fire Department on April 22, 2015 to further discuss the Massachusetts Fire Protection requirements for the Grafton and Upton Railroad LPGTF and information to be included in the FSAR. The following parties attended the meeting:

- Michael E. Gauthier, Fire Chief, Grafton, MA;
- Stephen Charest, Assistant Chief, Grafton, MA;
- Michael Mills, Deputy Chief, Grafton, MA;
- Jacob Nunnemacher, Office of the State Fire Marshal, Stow, MA;
- Doug Willardson, Assistant Town Administrator, Grafton, MA;
- Robert Berger, Inspector of Buildings, Grafton, MA;
- Stan Gordon, Grafton and Upton Railroad, Grafton, MA; and
- Dr. Robert Palermo, EBI Consulting, Burlington, MA.

1.1 Contents of Fire Safety Analysis Report

The purpose of the FSAR is to describe the current site conditions and fire safety design analysis undertaken by the G&UR for the Grafton, MA LPGTF. This FSAR is organized into the following report sections:

Section 1.0 Introduction;
Section 2.0 Facility and Area Description;
Section 3.0 Fire Safety Analysis;
Section 4.0 Applicable Guidance, Codes and Standards;
Section 5.0 Massachusetts Fire Protection Regulations;

The following references have been included as appendices to this report:

FIGURES:

TABLES:

APPENDIXES:

2.0 FACILITY & AREA DESCRIPTION

2.1 Facility Description

The G&UR LPGTF is located at 42 Westboro Street in Grafton, MA and occupies approximately 8.61 acres (see Appendix B). The LPGTF was designed by LPG Ventures located at 9611 E. 53rd Street in Raytown, MO. The LPGTF in its current form includes all of the tank conveyance pipework, tank and pipework supports, reinforced concrete piers, reinforced concrete truck loading pad, rail tank unloading area, tower and railtower supports, pumps and valves, and a control room. Four (4) 80,000 gallon steel above ground horizontal tanks are in the process of being installed on site as of the date of this report. When the LPGTF is operational LPG will be

transferred from rail cars into the four LPG tanks. Compressors/pumps are utilized to transfer the LPG from the railcars to the horizontal 80,000 gallon tanks during offloading and to transfer the LPG to the truck loading pad to accomplish fuel loading of LPG transfer trucks with a capacity of approximately 9,000 gallons each.

Figure 1 shows the location of the LPG terminal. Figure 2 includes an aerial view of the site and surrounding area. Figure 3 includes a USGS 7.5 Minute Topographic Map of the immediate area surrounding the site. Figure 4 includes the Grafton Assessors Map depicting the surrounding properties and Figure 5 includes the Grafton, MA Street Map.

2.2 Area Topography

The LPGTF is located adjacent to a wetland to the east with comparatively lower topographic elevations on site ranging from 350 to 360 feet above sea level (see Figure 3 topographic map and Appendix B Site Plan). The site gradually slopes to the east into the wetland area. A small water course is shown on Figure 3 which hydraulically connects Windel Pond, Pratts Pond and Hayes Pond. The railroad tracks are oriented along the western perimeter of the site.

2.3 Area Land Use

The Site is situated in a residential and commercial area with homes located to the north, west and east of the site. The locations of the properties surrounding the site are shown on Figure 4. The nearest receptors and distances from the G&UR LPGTF are described below:

Nearest Receptor Distances from the G&UR LPGTF

Description	Distance		Direction
	Feet	Yards	
Nearest Residential Occupancy	321	107	Southwest
Closest School	1,470	490	Southeast
Nearest Assembly Type Occupancy	771	257	Northwest

3.0 FIRE SAFETY ANALYSIS (FSA)

The principal elements of the Fire Safety Analysis (FSA) required by NFPA 58 are summarized below:

1. Effectiveness of product control measures;
2. Local conditions of hazard within the container site, including congestion within the Site;
3. Exposure to off-site properties and populations and the impact of neighboring industrial activity on the facility;

4. Effectiveness of the local Fire Department that may respond to an emergency within the facility;
5. Requirements for and availability of adequate water supply; and
6. Full compliance with code requirements for existing LP-Gas facilities and corrective actions to be implemented for a proposed facility to address any deficiencies.

The development of a FSA involves a number of steps as shown on Table 1.
The FSA requirements are presented in one or more tables and fill-in forms (see Appendix A for FSA completed forms). The tables provide either factual information or calculated results. The fill-in forms specify the NFPA 58 requirements and/or other assessment parameters, and provide two columns, one with a "Yes" column heading and the other with a "No" heading. In some cases either schematic or pictorial representations are provided to clarify a requirement. The fill-in forms require information input, either checking a "Yes" column or a "No" column, or writing a numerical value. Also provided are notes under each table or fill-in form to explain conditions, if any, associated with the table or the form or how a calculation is performed for entering data into the form.

3.1 Gas Line and Storage Container Safety Features

The LPGTF has been designed and constructed based on current best management practices (BMPs) as discussed in Section 3.0. The facility transfer lines and tanks will be equipped with protective valve devices including Emergency Shut Off Valves (ESV), Backflow Check Valves (BCK), Excess Flow Valves (EFV), Hydrostatic Pressure Relief Valve (PRV) and breakaway protection should a truck accidentally pull away from a loading area. The LPGTF uses both automatic and manual ESVs to shut down the LPG flow in the event of an emergency. A brief description of the types of valves used are provided below:

Positive Shutoff Valve: Manually operated shutoff valve used to control the flow of propane.

Backflow Check Valve: Valve allows flow in one direction only and is used to allow a container to be filled while preventing product from flowing out of the container.

Excess-Flow Valve: Valve designed to close when the liquid or vapor passing through it exceeds a prescribed flow rate.

Internal Valve: Primary shutoff valve for a container that can be closed remotely, which incorporates an internal excess flow valve with the seat and seat disc located within the container so that they remain in place should external damage occur to the valve.

Emergency Shutoff Valve: Shutoff valve incorporating thermal and manual means of closing that also provides for a remote means of closing.

Hydrostatic Pressure Relief Valve: Relief valve that is set to open and relieve pressure in a liquid hose or pipe segment between two shutoff valves when the pressure exceeds the setting of the valve.

Container Pressure Relief Valve: A type of pressure relief device designed to open and then close to prevent excess internal fluid pressure in a container without releasing the entire contents.

3.2 LPG Terminal Staffing and Hours of Operation

The G&UR LPGTF will be staffed with a full time manager/operator and up to 2-4 additional employees depending upon volume and will operate 24-hours a day 5-days per week. The facility will not operate on holidays or weekends.

3.3 Site Security and Illumination

The G&UR LPGTF will be secured with a galvanized steel mesh security fence and access gates around the entire perimeter of the facility. Access into and out of the facility will be monitored by the on site operator during all hours of operation. Video security will also be used and be in place at the facility. Adequate illumination is provided at nighttime to illuminate storage tanks, control valves and other required equipment.

3.4 Tank and Pipework Protection

Equipment exposed to vehicular movement will be protected with guard rails, steel bollards, crash pots or other equal means.

3.5 Separation Distances from Containers to Buildings and Property Lines

A minimum distance of 100 feet from above ground containers has been maintained to buildings and property lines.

3.6 Assessment of Sources of Ignition and Adjacent Combustible Materials

Minimum distances of 10 ft. are maintained from all combustible materials (grass, weeds, etc.) and 20 ft. between containers and tanks containing flammable liquids with a flash point < 200º F.

3.7 Use of Fire Extinguishing Equipment

Portable, dry chemical fire extinguishers with a minimum capacity of 18 lbs. and having a B:C fire rating will be employed at the LPGTF. A fire cannon water suppression system will also be in place at the facility to cool down the tanks in the case of a fire emergency (see Appendix E).

3.8 Ignition Control Procedures

Grounding legs and ignition control procedures will be employed during all LGP gas transfers. All electrical connections and lines have been classified for flammable gases and electrical circuits have been adequately protected to prevent an ignition from occurring.

4.0 APPLICABLE GUIDANCE, CODES AND STANDARDS

This section discusses the applicable best management practices (BMPs) and codes which have been incorporated into the design and operation of the G&UR LPGTF.

4.1 NFPA 58 – Liquefied Petroleum Gas Code

The FSA undertaken is based on the requirements outlined in NFPA 58. The LPGTF has been designed in full compliance with NFPA 58.

4.2 NFPA 15 - Standard for Water Spray Fixed Systems for Fire Protection

The standard helps to ensure effective fire control, extinguishment, prevention, or exposure protection through requirements for the design, installation, and system acceptance testing of water spray fixed systems for fire protection. It also contains requirements for the periodic testing and maintenance of ultra high-speed water spray fixed systems. The general requirements, system components, hydraulic calculations, system maintenance and installation requirements of NFPA 15 will be followed for the fixed water spray system installed.

The G&UR will utilize MPE, Inc. and Robert Ceppi, a Massachusetts licensed Fire Protection Engineer (PE), to design and oversee installation of the water conveyance system and water cannons to be installed on the G&UR LPGTF. A water line connection will be made in the vicinity of 42 Westboro Road to the 8 inch force main and will extend onto the site up to the connection of the water cannons (see Section 5.4 and Appendix D for hydrant test results and water supply availability).

4.3 NFPA 70 – National Electrical Code

Electrical devices used in hazardous areas have been certified for use according to the hazardous materials in the surrounding atmosphere as required by NFPA 70, Chapter 5, Article 500 and NFPA 497 – Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous Classified Locations. Propane is classified as a Class I, Division I, Group D flammable gas. Specific wiring methods or a combination of electrical methods including, seals in conduits and cable systems, explosion proof enclosures, enclosures for relays, motors and generators as described in Article 500 apply to Class I locations. The G&UR LPTF will be constructed to comply with the requirements of NFPA 70.

5.0 MASSACHUSETTS FIRE PROTECTION REGULATIONS

The Massachusetts fire protection regulations which apply to the design and operation of the LPGTF are discussed below.

5.1 527 CMR 1.00; Chapter 60.8 - Hazardous Materials Process or Processing

The G&UR LPGTF is classified as a Category 5 Process which by definition involves or produces hazardous material (HM) in a vessel with a capacity equal to or in excess of threshold quantities stated in 29 CFR 1910.119 or 40 CFR Part 68 and regulated by such standard. A

permit is required by 527 CMR 1.00; Chapter 60.8 to process HM and is submitted to and approved by the Head of the Fire Department on a form prescribed by the Fire Marshal. A facility is deemed in compliance with the permit requirements if a completed application form, signed and attested by the applicant, has been filed in accordance with Chapter 60.8.4.

Category 5 Processes must comply with the following requirements:

1. Implement and self-certify compliance with 29 CFR 1910.119 Process Safety Management of Highly Hazardous Chemicals or with 40 CFR Part 60 Chemical Accident Prevention Provisions;
2. Comply with the permitting requirements of Chapter 60.8.4;
3. Comply with the requirements of Chapter 60.5.1.4.3.2; and
4. Maintain hazard evaluation documents and records for review by the Head of the Fire Department or Marshal for a minimum of two years following issuance of a permit.

The OSHA Process Safety Management (PSM) Plan which has been prepared for the LPGTF has been developed to satisfy both the OSHA PSM standard and the Massachusetts Fire Protection regulations described in 527 CMR 1.00; Chapter 60.8.

5.2 502 CMR 5 – Permit and Inspection Requirements of Aboveground Storage Tanks of More than Ten Thousand Gallons Capacity

502 CMR 5.0 includes requirements and procedures for the installation, construction, maintenance and use of Aboveground Storage Tanks (ASTs) and related permit, inspection and record keeping requirements. If any one tank containing LP-gas exceeds 10,000 gallons, then the requirements of 502 CMR 5.0 apply. A Permit and annual inspection of ASTs or containers of more than 10,000 Gallon capacity must be undertaken and documentation of compliance with 502 CMR 5.0: Permit Requirements and Annual Inspection of ASTs or containers of more than ten thousand gallons' capacity shall be submitted with the application for a permit to install LP-gas. In accordance with 49 U.S.C. 10501 (b), the G&UR is not required to obtain a permit but will fully comply with the requirements of 502 CMR.

5.3 527 CMR 1.00; Chapter 60 and Chapter 69 – Liquefied Petroleum Gas Containers and Systems

Chapters 60 and 69 prescribes the minimum standards for LP-gas systems for the protection and safety of the public at large. A Permit is required to install or connect any LP-gas storage equipment from the head of the fire department. The application is limited to the storage of LP-gas and the operation of LP-gas systems upstream from the outlet of the first stage regulator. Chapters 60 and 69 adopts and incorporates by reference NFPA 58. In the event of a conflict between the provisions of NFPA 58 and any other provision of Chapters 60 and 69, the standard that requires the greater level of safety will apply.

Railcar shipments of LP-gas intended for distribution within Massachusetts must comply with the odorization thresholds, testing and filling of containers provisions. If ethyl mercaptan is used for odorization purposes, it must be injected at a minimum rate of 1 pound per 10,000 gallons of propane. Each railcar shipment delivered to a bulk plant for distribution is to be tested for odorization using one of the following test methods:

For testing purposes, one of the following tests is required to determine adequate ethyl mercaptan odorant levels equivalent to 1 pound per 10,000 gallons of propane.

(a) Vapor Test using stain tubes resulting in a minimum of 5 ppm of ethyl mercaptan utilizing ASTM D 5305; or

(b) Flash Vapor Test using stain tubes resulting in a minimum of 17 ppm of ethyl mercaptan utilizing ASTM D 5305; or

(c) Liquid Test for analysis of volatile sulfurs using gas chromatography resulting in a minimum of 17 ppm of ethyl mercaptan utilizing ASTM D1265.

Effective September 1, 2014, each person handling LP-gas in the quantities of 42 pounds (ten gallons) or greater, shall be trained, in accordance with the Certified Employee Training Program (CETP) or other education programs acceptable to the Marshal. Each person handling cylinders less than 42 pounds shall receive annual training utilizing the program Dispensing Propane Safely published by the Propane Education and Research Council (PERC).

Where a gas leak results in imminent danger, immediate verbal notification must be provided to the head of the fire department, and followed by written notification within 24-hours of verbal notification documenting the date, time, and the location of discovery and status of such event.

"NO SMOKING" and "STOP ENGINE WHEN REFUELING" signs must be displayed on the front and rear of tanks from which trucks are loaded. The signs shall have block letters at least one inch high with either red letters on a white background or white letters on a red background.

5.4 Completed Fire Safety Analysis Forms

Appendix A contains the completed FSA Forms which were developed by the National Fire Protection Association (NFPA) and the National Propane Gas Association, 2011 Edition. The FSA was conducted by Dr. Robert S. Palermo a registered Professional Engineer (PE) and Licensed Site Professional (LSP) in Massachusetts. Dr. Palermo is also a Certified Safety Professional (CSP) in comprehensive practice through the Board of Certified Safety Professional (BCSP) and a Registered Professional Industrial Hygienist (RPIH) though the Association of Professional Industrial Hygienists. Dr. Palermo has over thirty years of experience preparing facility plans (e.g., Contingency Plans, Emergency Response Plans, Process Safety Management Plans, etc.) and conducting OSHA HAZWOPER and HAZMAT spill response training.

There were no major deficiencies identified as a result of the FSA. Multiple redundant fail safe systems are to be installed at the facility as described in Chapter 6.26 of NFPA 58, 2011 Edition. These systems are being installed to ensure that safety is incorporated into as many elements of the facility design and operation as can be accomplished.

5.5 Site Plan

The G&UR retained the services of Arthur F. Borden & Associates, Inc. of Raynham, MA on May 7, 2015 to update the existing site plan to reflect existing conditions. The site plan is included in Appendix B and shows the general layout of the site including the existing buildings, structures, railroad lines, truck loading pad, offloading rack, and locations of the proposed LPG tanks and associated pipework.

5.6 Foundations and Tank Pier Designs

The G&UR retained the services of Geotechnical Consultants, Inc. (GC) of Grafton, MA to conduct in situ compressive strength test on the concrete and to monitor for suitable soil and soil conditions. The results of their testing are included in Appendix C along with the foundation plans and drawings. Mr. Richard Pizzi of GC, a registered professional engineer (PE) in Massachusetts, supervised the work and noted that the compressive strength of the concrete of 3,330 and 3,880 pounds per square inch (psi) exceeds the required design strength.

6.0 ADEQUACY OF WATER SUPPLY & USE OF WATER CANNONS

6.1 Results of Fire Hydrant Testing on October 5, 2011

Mr. Robert Ceppi, a licensed Fire Protection Engineer (PE) in Massachusetts of MPE located in Hebron, CT, performed the initial hydrant flow testing in Grafton, MA on 42 Westboro Street in the area of the rail yard on October 5, 2012. Mr. Ceppi's report, which discusses the findings of his hydrant test, is included in Appendix G. The hydrant flow test results note that the town has a good 8 inch and 12 inch water mains that provide water flow to the 6 inch main in front of the rail yard from both directions.

It is noted in the report that the last section of 6 inch pipe on 42 Westboro Street in front of the rail yard was to be replaced in 2013. During the flow tests the hydrant water flows were restricted by the Town representative from the Water Department due to an expressed concern that if the hydrant valves were opened too much they may have difficulty closing them back off.

Mr. Ceppi's hydrant testing report indicates that there is a sufficient supply of water along Westboro Road to the hydrants to satisfy the water demand at the G&UR LPGTF in the event of a fire. The water line connection will be approved by the Grafton Water District prior to performing the work. The G&UR current plan is to install four (4) water cannons located on site in the immediate vicinity of the LPG tanks. The 8 inch pipeline extension brought onto the site will provide sufficient volumetric flow in gallon per minute (gpm) to cool 3 of the 4 LPG tanks in the event of a fire. FSA Form 8.3, found in Appendix A, identified a requirement of 512

gallons per minute (gpm) for each 80,000 gallon tank with a surface area of 4,098 ft.^{2} per LPG tank. The total water demand is 1,536 gallons for three tanks and an additional 250 gpm for fire fighter protection and rounding up to the nearest multiple of 125 (1,625 gallons + 250 gallons) results in a total combined volumetric flow of 1,875 gpm. Mr. Ceppi's report notes that the available flow is 3,660 gpm at 20 psi which more than exceeds the requirements identified on FSA Form 8.3 of 1,875 gpm. This was reconfirmed by follow up hydrant testing conducted by Mr. Ceppi on June 4, 2015 along 42 Westboro Road which resulted in a total volumetric flow of 4,050 at 20 psi (see Appendix D results).

6.2 Results of Fire Hydrant Testing on June 4, 2015

Mr. Robert Ceppi of MPE, Inc. performed a second hydrant test near 42 Westboro Street on June 4, 2015 at a different fire hydrant location. Again the results of the fire hydrant testing indicated that the hydrant water supply is more than adequate to supply sufficient water to cool the tanks in the event of a fire emergency. The results of the June 4 2015 hydrant testing are included in Appendix D and indicate that the available water flow at 20 psi is 4,050 gpm from the hydrant tested on 42 Westboro Road.

6.3 Use of Water Cannons for Tank Cooling and Fire Suppression

Mr. Robert Ceppi of MPE has designed the water cannon fire suppression system to be used at the LPGTF for the purpose of cooling the tanks in the event of a fire emergency. The basis for the water cannon designed is included in Appendix E. The water suppression system provides for four water cannon nozzles which can be used to direct water directly onto the tanks if needed. The water cannons can reach out approximately 130 ft. with a water stream which can be directed at any of the four tanks based on its range in elevation and angle of lateral rotation.

The water cannon plan layout is included in Appendix E and shows the locations of the 4 water cannons which will serve the purpose of providing water to the LPG tanks, rail cars and truck loading areas. A new 8 inch fire protection water main will be connected to the existing Grafton, MA water main in the street and extend onto the LPGTF as shown on the proposed water cannon layout in Appendix E. As shown on Figure 17 Range - Characteristics of Straight Stream Nozzles, the PC-60 nozzle has a flow range of approximately 130 to 140 feet with an estimated water flow of 480 gpm.

7.0 EMERGENCY ACTION PLAN

An Emergency Action Plan (EAP) will be developed for the LPGTF based on the requirements outlined in Subpart E – Exit Routes, Emergency Action Plans, and Fire Prevention Plans; 29 CFR 1910.33 and Process Safety Management of Highly Hazardous Chemicals, Emergency Planning and Response; 29 CFR 1910.119(n).

8.0 SUMMARY/RECOMMENDATIONS

This section outlines additional work that needs to be undertaken to comply BMPs, applicable codes, and state regulations as described in Sections 4 and 5 above.

Recommendations:

1. An eight inch water line extension needs to be brought onto the site from Westboro Street to provide adequate water pressure and flow for the water cannons used to cool tanks, rail cars and trucks in the event of a fire. Install fixed water spray system in conformance with NFPA 15 (e.g., water cannons).
2. Emergency back up power needs to be provided to the LPGTF to supply emergency power in the event of a power failure. The ESVs are electromechanical valves which are normally open when electrical power is supplied and in the event of a power failure, the ESVs would completely close off the entire propane system. Emergency lighting, propane gas sensors and the audio and visual alarm system will require emergency backup power to operate in the event of a power failure due to a storm or heavy snowfall event.
3. A Fire Prevention Plan will be prepared and operation personnel will be trained on the plan.
4. Information will be provided to the Town of Grafton and submitted to the Town of Grafton, MA Fire Department as required by the noted Massachusetts Fire Protection regulations as noted in Section 5.
5. Facility operations personnel must be trained in accordance with the PERC and the NPGA required training for operators, and complete the Certified Employee Training Program (CETP) or other education programs acceptable to the Fire Marshal.
6. As noted on FSA Form 9.2 contained in Appendix A, an alarm system indicating that propane gas is present in the rail yard and tank storage locations, should be installed.

9.0 LIMITATIONS

The FSAR was based on requirements outlined in the Fire Safety Analysis Manual for LP-Gas Storage Facilities which addresses the requirements outlined in the 2011 Edition of NFPA 58 Liquefied Petroleum Gas Code developed by the National Fire Protection Association (NFPA) and the National Propane Gas Association (NPGA). The Fire Safety Analysis (FSA) completed is a self-conducted audit of the safety features of the G&UR LPGTF propane facility and an assessment of the means to minimize the potential for inadvertent propane releases from containers and during transfer operations. The assessment also includes an evaluation of the capabilities of local emergency response agencies as well as an analysis of potentially hazardous exposures from the installation to the neighborhood and from the surroundings to the LP-Gas facility. The FSA and FSAR at the time of preparation was representative of current Site conditions.

This FSAR was specifically prepared for the G&UR and may not be used or reproduced without the permission of the G&UR. This report contains information regarding fire safety analysis

and compliance with BMPs and fire protection regulations. It is not intended to address other requirements or conditions that may apply to the G&UR LPGTF under federal regulations (e.g., OSHA General Industry Standards and EPA Chemical Accident Prevention Provisions). These requirements are addressed under separate plans and are identified in the reference section which follows.

10.0 REFERENCES

The following references apply to this FSAR:

1. Occupational Safety and Health Administration (OSHA), Process Safety Management of Highly Hazardous Chemicals; 29 CFR 1910.119.
2. Occupational Safety and Health Administration (OSHA), Hazard Communication/Global Harmonization System (GHS); 29 CFR 1910.1200.
3. Occupational Safety and Health Administration (OSHA), Emergency Action Plan (EAP); 29 CFR 1910.38.
4. Occupational Safety and Health Administration (OSHA), Fire Prevention Plan (FPP); 29 CFR 1910.39.
5. Occupational Safety and Health Administration (OSHA), Hazardous Waste Operations and Emergency Response (HAZWOPER); 29 CFR 1910.120.
6. Occupational Safety and Health Administration (OSHA), Personal Protective Equipment (PPE); 29 CFR 1910.132.
7. Occupational Safety and Health Administration (OSHA), The Control of Hazardous Energy (LOTO); 29 CFR 1910.147.
8. Occupational Safety and Health Administration (OSHA), Respiratory Protection; 29 CFR 1910.134.
9. Occupational Safety and Health Administration (OSHA), Hot Work Programs; 29 CFR 1910.252.
10. U.S. Environmental Protection Agency (EPA), Risk Management Plan (RMP); 40 CFR Part 68; Section 112(r).
11. Massachusetts Fire Protection Regulations, 527 CMR 1.00; Chapter 60.8; Hazardous Materials Process or Processing.
12. Massachusetts Fire Protection Regulations; 527 CMR 1.00; Chapter 60 and Chapter 69 - Liquefied Petroleum Gas Containers and Systems.
13. Massachusetts Fire Protection Regulations; 502 CMR 5.00 - Permit and Inspection Requirements of Aboveground Storage Tanks of More Than 10,000 Gallons Capacity.
14. National Fire Protection Code (NFPA) 58 – Liquefied Petroleum Gas Code.
15. National Fire Protection Code (NFPA) 15 - Standard for Water Spray Fixed Systems for Fire Protection.
16. National Fire Protection Code (NFPA) 70 – National Electrical Code.
17. National Fire Protection Code (NFPA) and National Propane Gas Association (NPGA) Fire Safety Analysis Manual for LP-Gas Storage Facilities.

Figures:

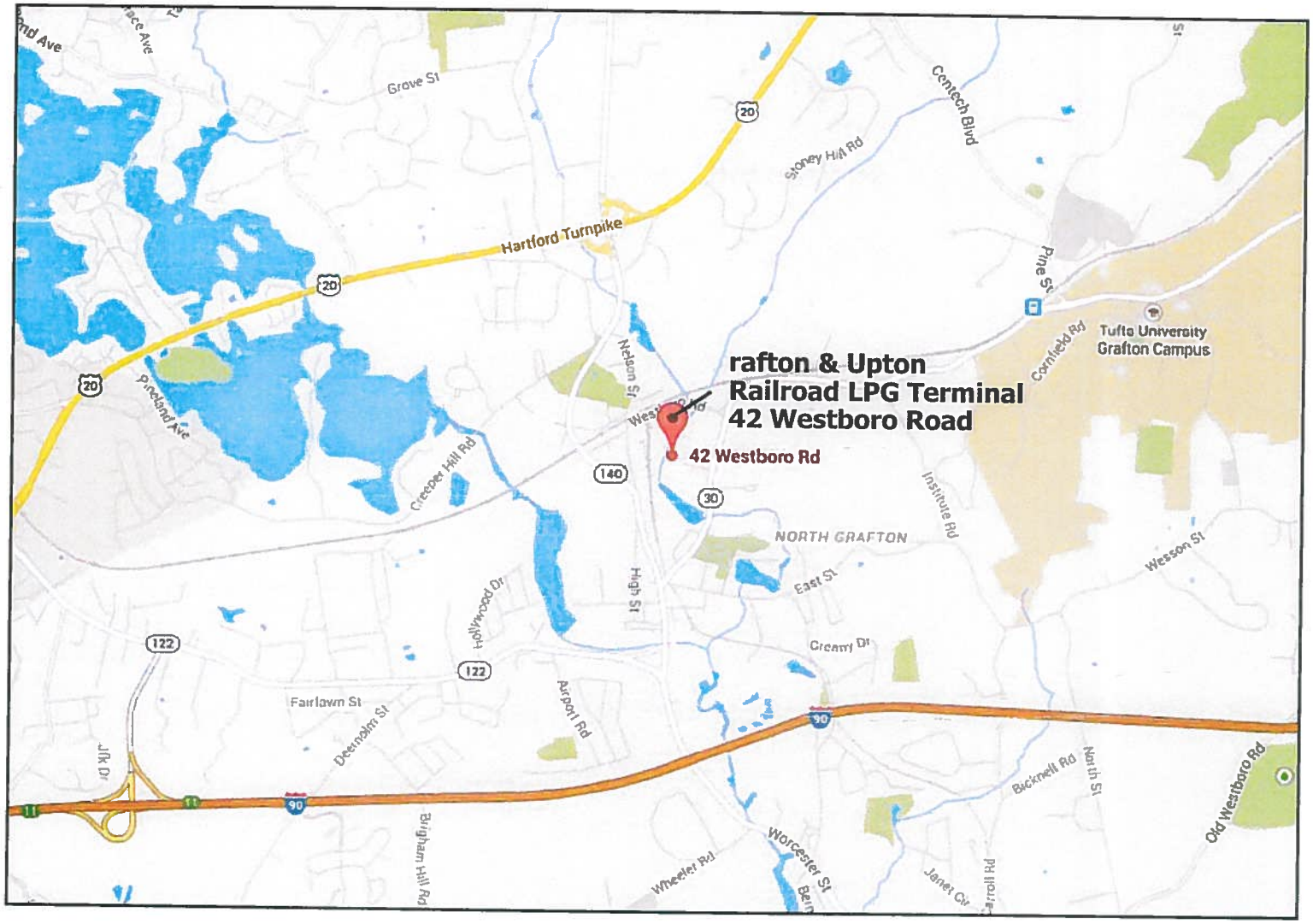


Figure 1 - Facility Location Map

Figure 2 – Site Aerial Photograph and Surrounding Area

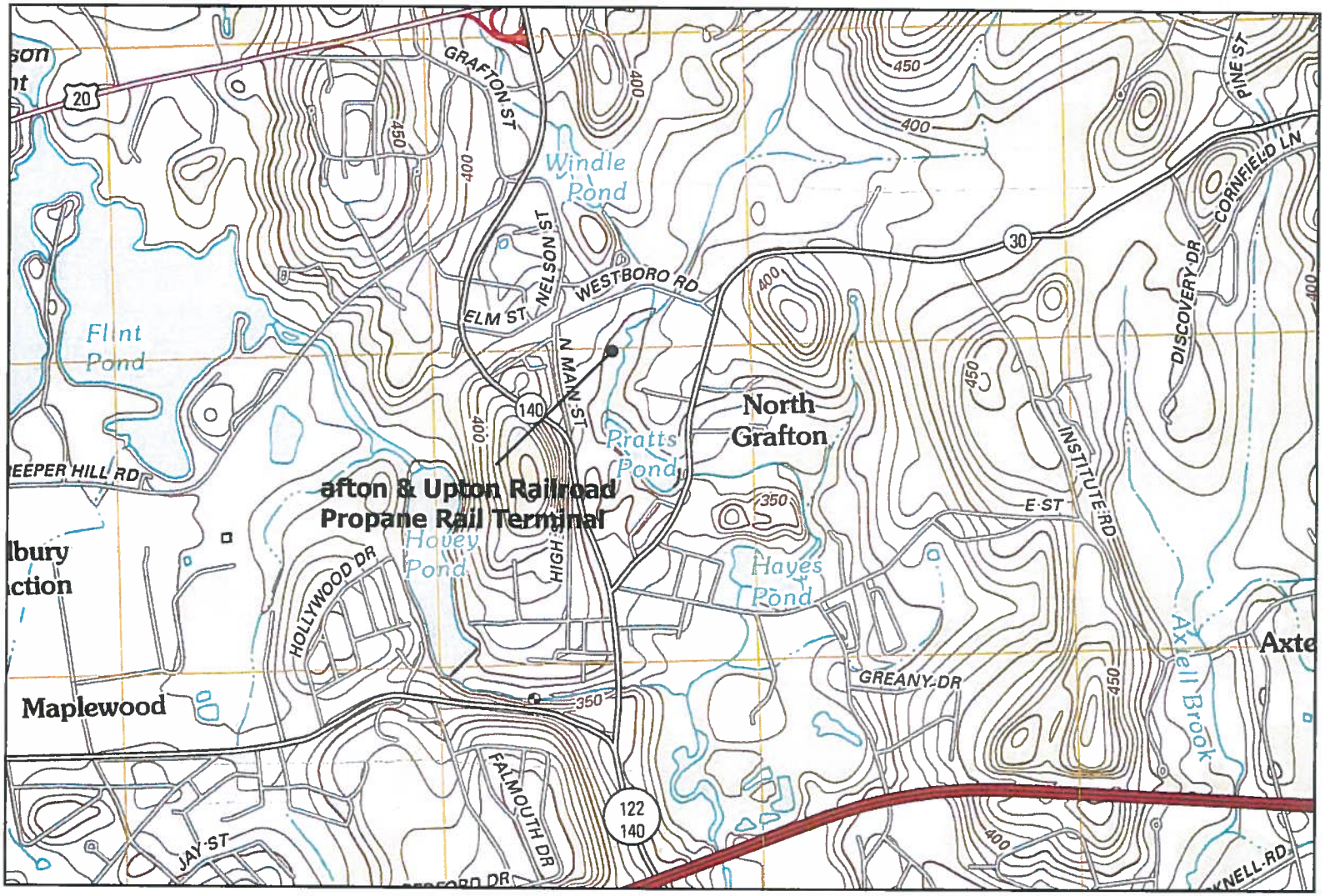
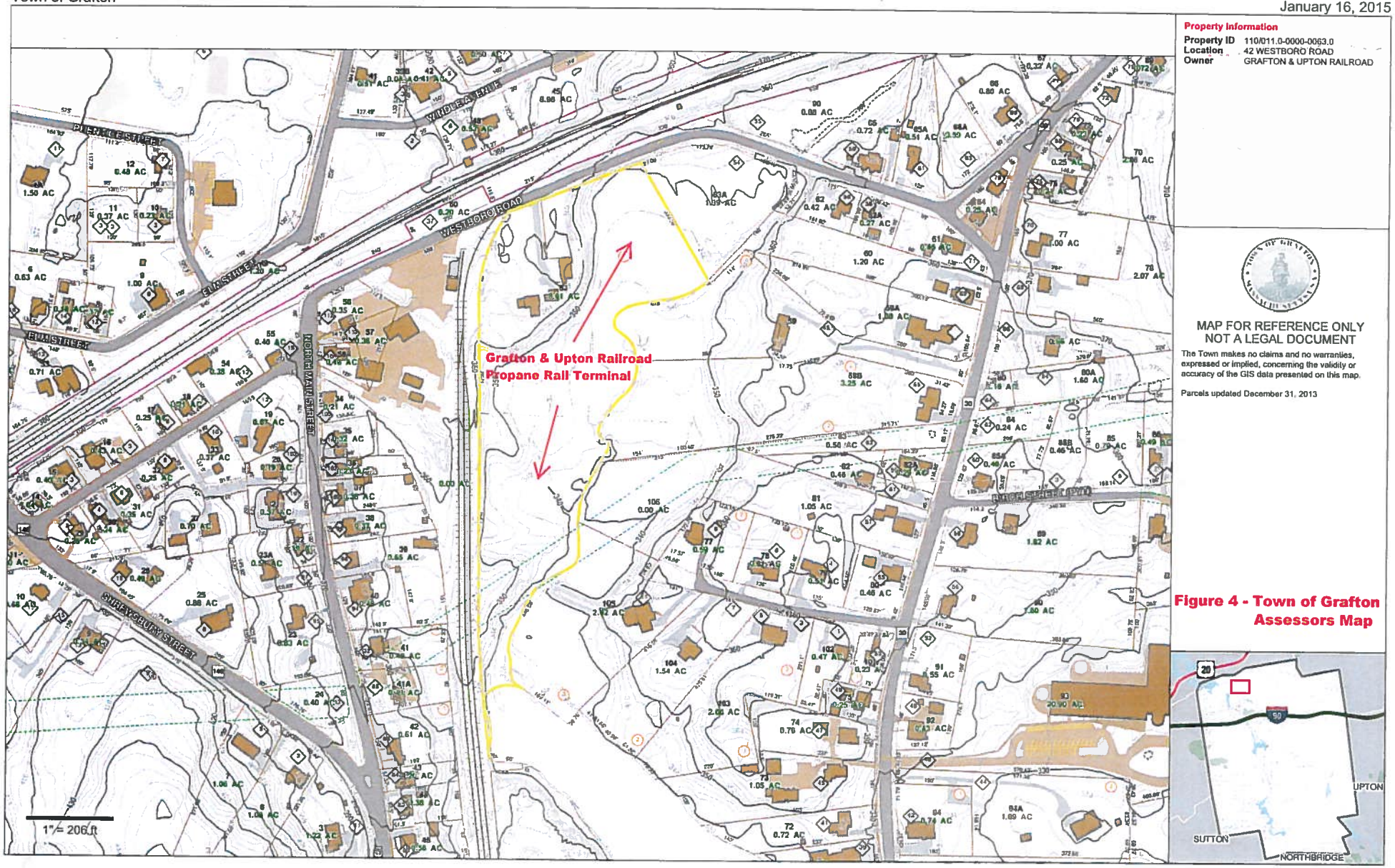


Figure 3 - USGS Grafton, Massachusetts 7.5 Minute Topographic Map

Town of Grafton

January 16, 2015



Property Information

Property ID	110/011.0-0000-0063.0
Location	42 WESTBORO ROAD
Owner	GRAFTON & UPTON RAILROAD

MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

The Town makes no claims and no warranties, expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Parcels updated December 31, 2013

Figure 4 - Town of Grafton Assessors Map

Town of Grafton, Massachusetts - Street Map*

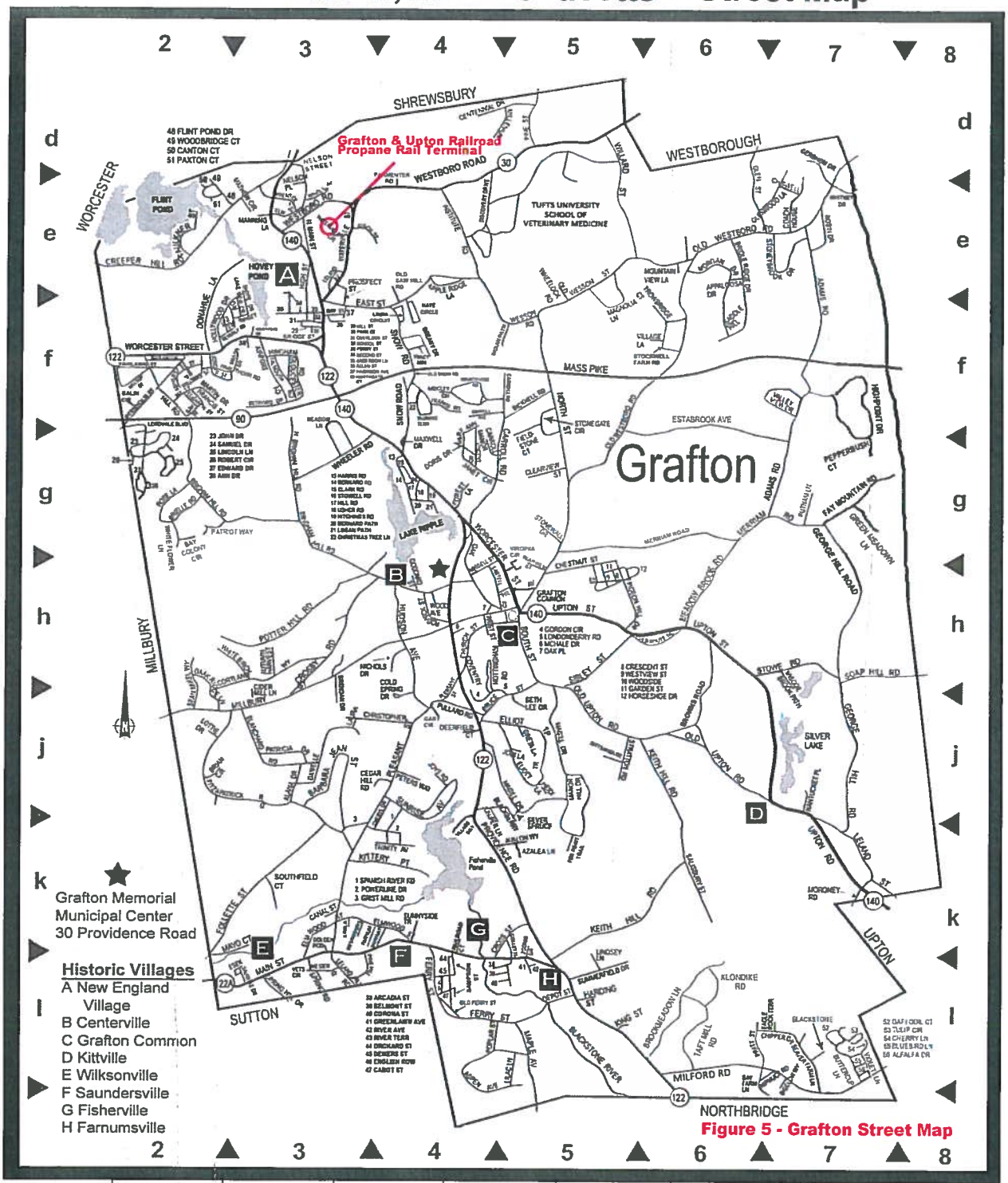


Figure 5 - Grafton Street Map

*For reference only. Not an official street map.

Updated 11.2013

Tables:

Table 1
Description of the Various Steps in Performing the FSA

Step No.	FSA Steps	Chapter Where Described
1	Gather data on the volume of LP-Gas stored and other information pertinent to the facility.	Chapter 4
2	Perform simple calculations and determine whether the facility is subject to the requirements for developing an FSA.	
3	Evaluate the product control appurtenances and other safety features of the facility relative to the requirements of the NFPA 58 code.	Chapter 5
4	Assess the appurtenance requirements for containers of different capacities and compare them to the actual installation.	
5	Evaluate the requirements for valves on transfer piping and compare them to the valves provided in the facility.	
6	Assess conformance to the code of a Redundant and Fail-Safe Product Control System, if such a system is provided in the facility.	
7	Evaluate the code conformance of the Low Emission Transfer Equipment if installed in the facility.	
8	Analyze the protection measures against local conditions of hazard. That is, assess whether all requirements of the code for the physical protection of containers and transfer piping are implemented.	Chapter 6
9	Analyze the code requirements for the control of ignition sources and whether these requirements are complied with.	
10	Assess conformance to the code requirements for separation distances between (i) containers of different sizes and property and, (ii) LP-Gas transfer points and other exposures.	
11	Evaluate conformance to the code requirements for Special Protection Systems, if they are provided on containers in the facility.	
12	Evaluate the potential hazards to off-site populations and property from propane releases in the facility. This step includes selecting credible LP-Gas release scenarios and assessing the distance (and area) over which the hazard exists.	Chapter 7
13	Assess whether any off-site populations, especially people in institutional occupancies, are potentially subject to the LP-Gas release hazards	
14	Evaluate whether there exists a hazard from other industrial operations around the LP-Gas facility	
15	Evaluate the effectiveness of the local Fire Department, including the availability and capability of response personnel, training level, equipment and response time to an emergency in the facility.	Chapter 8
16	Evaluate the amount of water needed to cool containers exposed to a fire and the adequacy of the facility (or locally available) water supply.	
17	For a proposed facility, develop corrective actions to address deficiencies found.	Chapter 9 (Only applicable for proposed facilities)
18	Assess, based on specific criteria, the need to provide Redundant and Fail-Safe Product Control Systems.	
19	Assess, based on specific criteria, the need to provide Low Emission Transfer Systems.	
20	Assess when Special Protection Systems are needed	
21	Evaluate alternative approaches to using water in a special protection system	

Appendixes:

Appendix A –
NFPA 58, Fire Safety Analysis Completed Forms 4.1 through 9.7

Appendix A

Fill-in Forms

This Appendix contains a set of forms copied from the different chapters in this manual. The form number corresponds to the respective forms in chapters 4 through 9; the first number digit represents the chapter number. Where the forms refer to a figure, it is understood that they refer to the figures shown in the main body of the manual.

The details of how to use the forms and what the results mean are indicated in the respective chapters; the user should refer to the information in the various chapters before using these forms.

The filled-in forms may then be included in the written Fire Safety Analysis that has to be maintained by the LP-Gas facility owner/operator. If a need exists, the same report may be submitted to the Authority Having Jurisdiction (AHJ).

How to Use the Forms in this Section
This Microsoft Word document contains tables with fill-in blanks, or form fields, in which you enter information. These tables are made of cells, and the ones in which you may enter information contain gray shading.

The following types of form fields are included in this Appendix:

Regular Text: Accepts text, numbers, symbols, or spaces.

Number: Only allows a number. If you enter a letter into this field, it will change to a zero after you leave the field.

Calculation: Uses a formula to calculate numbers, such as the sum of two columns automatically appears in another column. Users cannot fill in or change this field, even though it contains gray shading. **Users must click in another number field to activate the calculations.**

Checkbox: Shows the selection state of an item. When the box is empty, or unchecked, click it to make an X appear. When the box is checked and contains an X, click the box to remove it. Examples: Unchecked: ☐ Checked: ☒

The form fields are already set up to only accept a certain type of input (numbers only or numbers and letters) and contain the formulas needed for automatically performing calculations. Users are not permitted to use the other fields in the forms (for example, change Item #s or values already in the form). Once the forms are completed, this document is saved using File→Save, like a regular Microsoft Word document.

Form 4.1
Initial Data on the LP-Gas Facility

A	B	C
Item #	Information Item	Data
1	**Name of the LP-Gas Plant Owner or Operator**	Grafton & Upton Railroad
2	**Contact Name:**	Stan Gordon, Vice President
3	**Contact Telephone & Fax Numbers**	Office: 1-508-481-6095
4	**Contact Email Address**	sgordon@firstcolonydev.com
5	**Mailing Address**	Street 1: 42 Westboro Road
		Street 2:
		City, State, Zip: Grafton, MA 01536

Form 4.2
Facility Storage Capacity[1,2,3]

A	B	C	D
#	Individual Container Water Capacity (wc) (gallons)	Number of containers	Total Water Capacity (wc) of each container size (gallons)
1	500		0
	1,000		0
	2,000		0
	4,000		0
	10,000		0
	18,000		0
	30,000		0
	60,000		0
	Other:80,000	4	320,000
	Other:		0
	Other:		0
	Other:		0
2	**Aggregate Water Capacity**		320,000

Notes:
(1) Column D = Column B x Column C.
(2) Parked bobtails, transports and tank cars should not be considered for aggregate capacity calculations.
(3) Do not consider containers that are not connected for use.
(4) ***For the purpose of this manual, "Aggregate Water Capacity" means any group of single ASME storage containers separated from each other by distances less than those stated in the aboveground containers column of Table 6.3.1.***
(5) This form contains formulas that will automatically calculate results based on the values entered in the related cells. To activate the calculations, click in another number field, such as one in Column C.

If the aggregate water capacity of the LP-Gas facility is less than or equal to 4,000 gallon (w.c.), no further assessment is required.

YOU CAN STOP HERE.

Form 4.3
Additional Information on the LP-Gas Facility

☒ Existing Facility; Built to NFPA 58 Edition 2011 ☒ Proposed Facility

a) Name of the Facility (if applicable): Grafton & Upton Railroad LPG Transfer Facility

b) Type of LP-Gas Facility: ☐ Commercial ☐ Industrial ☒ Bulk Plant

c) Facility is located in: ☒ City Industrial Zone ☐ Suburban Area ☐ Rural Area
☐ City Commercial Zone

d) Facility neighbors§: ☐ Agri Fields ☐ Commercial Blds. ☐ Flammable Liquids Storage
(Check all that apply) ☒ Industrial Activity (metal fabrication, cutting and welding, etc.)
☐ Manufacturing ☒ Others (explain) Residences

e) Geographic Location of Facility/Address: 42 Westboro Road
Grafton, MA 01536

f) Landmarks, if any: _____
_____

g) LP-Gas liquid supply by: ☐ Bobtail ☐ Truck Transport ☒ Rail Tank Car
(Check all that apply) ☐ Pipeline

h) LP-Gas Distribution by: ☐ Liquid Piping ☒ Truck Transport ☐ Vapor Piping
Plant (Check all that apply): ☐ Bobtail ☐ Dispensing or Vehicle Liquid Fueling

i) Number of Vehicle Entrances: ☒ One ☐ Two ☐ More than two

j) Type of Access Roads to the Facility: ☐ Rural ☒ City or Town ☐ Highway
(One check per line) Entrance 1: ☐ Dirt road ☐ Gravel road ☒ Paved
(One check per line) Entrance 2: ☐ Dirt road ☐ Gravel road ☐ Paved

k) Staff presence: ☐ Not staffed ☐ Only during transfer operations
☒ Staffed always (24/7) ☒ Only during business hours
☐ Other (Explain) _____

l) Location and distances to Assembly, Educational or Institutional Occupancies surrounding the facility, if any, within 250 ft from the facility boundary in the direction of the assets. The Grafton Library is located 257 yards WNW from the G&UR LPG Transfer Facility.

n) Overview plot plan of the facility attached? ☒ Yes ☐ No

§ All properties either abutting the LP-Gas facility or within 250 feet of the container or transfer point nearest to facility boundary.

Form 5.1

Compliance with Code Requirements for Appurtenances on Containers of 2,000 Gallons Water Capacity or Less

Form 5.1 Not Applicable

A	B	C	D	E
Container #	Service Configuration Sub Figure (in Figure 5-1)	Number of Product Control Appurtenances		NFPA 58 Section Reference (2008 edition)
		Required by NFPA 58 (applicable edition)	Installed on the Container	
1				5.7.4.1 and Table 5.7.4.1
2				
3				
4				
5				
6				
7				

If, in Form 5.1, any one of the numbers in column D is less than the number in Column C of the corresponding row, then these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 5.2

Compliance with Code Requirements for Appurtenances on Containers Of water capacity 2001 gallons through 4,000 Gallons Used in Residential and Commercial Facilities

Form 5.2 Not Applicable

A	B	C	D	E
Container #	Service Configuration Sub Figure (in Figure 5-1)	Number of Product Control Appurtenances		NFPA 58 Section Reference (2008 edition)
		Required by NFPA 58 (applicable edition)	Installed on the Container	
1				5.7.4.1 and Table 5.7.4.1
2				
3				
4				
5				
6				

If, in Form 5.2, any one of the numbers in column D is less than the number in Column C of the corresponding row, these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 5.3

Compliance with Code Requirements for Appurtenances on Containers Having a Water Capacity of 2,001 through 4,000 Gallons Used in Bulk Plants and Industrial Plants

Not Applicable

A	B	C	D	E	F	G
Container #	LP-Gas inlet to and outlet from the container**		Figure #	Total Number of Product Control Appurtenances		NFPA 58 Section Reference (2008 edition)
				Required by NFPA 58 (applicable edition)	Installed on the container	
1	Vapor	Inlet	5-2			See §5.7.4.2 and Table 5.7.4.2
		Outlet	5-3			
	Liquid	Inlet	5-4			
		Outlet	5-5			
2	Vapor	Inlet	5-2			
		Outlet	5-3			
	Liquid	Inlet	5-4			
		Outlet	5-5			
3	Vapor	Inlet	5-2			
		Outlet	5-3			
	Liquid	Inlet	5-4			
		Outlet	5-5			
4	Vapor	Inlet	5-2			
		Outlet	5-3			
	Liquid	Inlet	5-4			
		Outlet	5-5			

** If the container does not provide an opening for the specific function listed, enter 0 (zero) in Columns E and F corresponding to that row.

If, in Form 5.3, any one of the numbers in Column F is less than the number in Column E of the corresponding row, these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 5.4

Compliance with Code Requirements for Appurtenances on Containers Having a Water Capacity Greater Than 4,000 Gallons Used in Bulk Plants and Industrial Plants

A	B	C	D	E	F	G
Container #	LP-Gas inlet to and outlet from the container**		Enter Configur-ation Number	Total Number of Product Control Appurtenances		NFPA 58 Section Reference (2008 edition)
				Required by NFPA 58 (applicable edition)	Installed on the container	
1	Vapor	Inlet	5-2	1	1	See §5.7.4.2 and Table 5.7.4.2
		Outlet	5-3	1	1	
	Liquid	Inlet	5-6	1	1	
		Outlet	5-7	2	2	
2	Vapor	Inlet	5-2	1	1	
		Outlet	5-3	1	1	
	Liquid	Inlet	5-6	1	1	
		Outlet	5-7	2	2	
3	Vapor	Inlet	5-2	1	1	
		Outlet	5-3	1	1	
	Liquid	Inlet	5-6	1	1	
		Outlet	5-7	2	2	
4	Vapor	Inlet	5-2	1	1	
		Outlet	5-3	1	1	
	Liquid	Inlet	5-6	1	1	
		Outlet	5-7	2	2	

** If the container does not provide an opening for the specific function listed, enter 0 (zero) in columns E and F corresponding to that row.

If in Form 5.4 any one of the numbers in column F is less than the number in Column E of the corresponding row, these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 5.5
Requirements for Transfer Lines of 1½-inch Diameter or Larger, Liquid-into-Containers

A	B	C	D	E	F
Item #	Appurtenance (Either No. 1 or No. 2)**	Appurtenance Provided with the Feature	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2008 edition)
1	Emergency Shutoff Valve (ESV) (Ref § 6.12)	Installed within 20 ft. of lineal pipe from the nearest end of the hose or swivel-type connections.	x		6.12.2
		Automatic shutoff through thermal (fire) actuation with melting point of thermal element < 250 °F	x		6.12.6
		Temperature sensitive element (fusible link) installed within 5 ft from the nearest end of the hose or swivel type piping connected to liquid transfer line,	x		6.12.6
		Manual shutoff feature provided at ESV installed location.	x		6.12.10 (1)
		Manual shutoff device provided at a remote location, not less than 25 ft., and not more than 100 ft. from the ESV.	x		6.12.10 (2)
		An ESV is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of size 1½ inch in diameter or larger on the other side.	x		6.12.5 6.18.2.6 (1)
		Breakaway stanchion is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	x		6.12.8
			Yes	No	
2	Back flow Check Valve (BCK)**	Installed downstream of the hose or swivel-type connection	x		6.12.8
		BCK is designed for this specific application.	x		6.12.4
		A BCK is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1½ inch in diameter or larger on the other side.	x		6.12.5
		Breakaway stanchion is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	x		6.12.8

** In lieu of an emergency shutoff valve, the backflow check valve (BCK) is only permitted when flow is only into the container and shall have a metal-to-metal seat or a primary resilient seat with metal backup, not hinged with a combustible material (6.12.3, 6.12.4).

Form 5.6
Requirements for Transfer Lines of 1½-inch Diameter or Larger, Liquid Withdrawal from Containers

A	B	C	D	E	F
Item #	Appurtenance	Appurtenance Provided with the Feature	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2008 Edition)
1	Emergency Shutoff Valve (ESV) (Ref § 6.12.1)	Installed within 20 ft. of lineal pipe from the nearest end of the hose or swivel-type connections.	x		6.12.2
		Automatic shutoff through thermal (fire) actuation with melting point of thermal element < 250 °F	x		6.12.6
		Temperature sensitive element installed within 5 ft from the nearest end of the hose or swivel type piping connected to liquid transfer line.	x		6.12.6
		Manual shutoff feature provided at E SV installed location.	x		6.12.10 (1)
		Manual shutoff device provided at a remote location, not less than 25 ft., and not more than 100 ft. from the ESV.	x		6.12.10 (2)
		An ESV is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1½ inch in diameter or larger on the other side.	x		6.12.5 6.18.2.6 (1)
		Breakaway stanchion is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	x		6.12.8
		Number of ESV's in liquid withdrawal service	8		

Note: If more than one ESV is installed in the facility, use one Form 5.6 for each ESV.

Form 5.7
Requirements for Vapor Transfer Lines 1¼-inch Diameter or Larger

A	B	C	D	E	F
Item #	Appurtenance	Appurtenance Provided with the Feature	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2008 edition)
1	Emergency Shutoff Valve (ESV)	Installed within 20 ft. of lineal pipe from the nearest end of the hose or swivel-type connections.	x		6.12.2
		Automatic shutoff through thermal (fire) actuation with melting point of thermal element < 250 °F	x		6.12.6
		Temperature sensitive element installed within 5 ft from the nearest end of the hose or swivel type piping connected to liquid transfer line,	x		6.12.6
		Manual shutoff feature provided at E SV installed location.	x		6.12.10(1)
		Manual shutoff device provided at a remote location, not less than 25 ft., and not more than 100 ft. from the ESV.	x		6.12.10(2)
		An ESV is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1-1/4 inch in diameter or larger on the other side.	x		6.12.5 6.18.2.6 (1)
		Breakaway stanchion is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	x		6.12.8
2	Back flow Check Valve (BCK)**	Installed downstream of the hose or swivel-type connection	x		6.12.8
		BCK is designed for this specific application.	x		6.12.3 and 6.12.4
		A BCK is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1-1/4 inch in diameter or larger on the other side.	x		6.12.5
		Breakaway protection is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	x		6.12.8

** In lieu of an emergency shutoff valve, the backflow check valve (BCK) is only permitted when flow is only into the container and it shall have a metal-to-metal seat or a primary resilient seat with metal backup, not hinged with a combustible material (6.12.3, 6.12.4).

If a checkmark is made in the "No" column of any one of Form 5.5, Form 5.6 or Form 5.7, then these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

If the LP-Gas facility is designed using ALTERNATE PROVISIONS for the installation of ASME CONTAINERS, then continue the analysis below. Otherwise skip Forms 5.8 and 5.9 and go to Chapter 6.

Form 5.8
Evaluation of Redundant and Fail-Safe Design

A	B		C	D	E	F
#	Description		Features	Installed in the facility?		NFPA 58 Section Reference (2008 edition)
				Yes	No	
1	Container Sizes for which the appurtenances are provided		Appurtenances and Redundant Fail-Safe equipment are provided for <u>each</u> container of water capacity 2,001 gal. through 30,000 gal.	NA	NA	6.26.3 and 6.26.4
2	Liquid or Vapor withdrawal (1-1/4 in. or larger)		Internal Valve with integral excess flow valve or excess flow protection	x		6.26.3.1
			Positive Shutoff Valve installed as close as possible to the Internal Valve	x		6.26.3.4
3	Liquid or Vapor Inlet		Internal Valve with integral excess flow valve or excess flow protection or Back Flow Check valve	x		6.26.3.5
			Positive Shutoff Valve installed as close as possible to the Internal Valve or the back flow check valve	x		6.26.3.5
4	Railcar Transfer	Flow Into or Out of Railroad tank car	Approved emergency shutoff valves installed in the transfer hose or the swivel-type piping at the tank car end	x		6.18.2.6(1) and 6.26.4.1
		Flow Only into railroad tank car	Approved emergency shutoff valve or backflow check valve installed in the transfer hose or the swivel-type piping at the tank car end	x		6.18.2.6 (2) and 6.26.4.1
5	Cargo Tank Transfer		Protection provided in accordance with 6.26.4.1	x		6.26.4.1
6	Automatic closure of all primary valves (IV & ESV) in an Emergency		Actuated by Fire Detection	x		6.26.4.2
			Actuated by a hose pull-away due to vehicle motion	x		6.24.4.2
7	Manually operated remote shutdown of IV and ESV		Remote shutdown station within 15 ft of the point of transfer?	x		6.26.4.3(A)
			Another remote shutdown station between 25 ft and 100 ft of the transfer point?	x		6.26.4.3(B)
			Shutdown stations will shut down electrical power supply, if any, to the transfer equipment and primary valves?	x		6.26.4.3
			Signs complying with the requirements of 6.24.4..3 (C) provided?	x		6.26.4.3 (C)

Note: If the facility does not have a rail terminal, enter "NA" in both the "Yes" Column and the "No" Column in item 4 of this Form in the railroad tank car row. Similar option is also available if there is no cargo tank vehicle transfer station.
NA: means not applicable.

If the LP-Gas facility is provided with LOW EMISSION TRANSFER EQUIPMENT, then complete Form 5.9 below. Otherwise skip section 5.3.2 and go to Chapter 6.

Form 5.9
Evaluation of Low Emission Transfer Equipment

A	B	C		D	E	F
ITEM #	Description	Features		Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2008 Edition)
1	Transfer into Cylinders or ASME Containers on Vehicles	Delivery Nozzle and Filler Valve- Max. Liquid Release after transfer of 4 cc.	Fixed Maximum Liquid Level Gage not used during transfer operations	NA	NA	6.26.5.1 (B)
2	Transfer into Stationary ASME Containers. Delivery valve and nozzle combination	During product transfer or post transfer uncoupling of the hose, liquid product volume released to the atmosphere	does not exceed 4 cc (0.24 in^3) from a hose of nominal size 1 in or smaller	NA	NA	6.26.5.1(A)
			does not exceed 15 cc (0.91 in^3) from a hose of nominal size larger than 1 in.	NA	NA	6.26.5.2 (B)
3	Transfer into Stationary ASME Containers Maximum filling limit	Do containers of less than 2,001 gal (w.c.) have an overfilling prevention device or another approved device?		NA	NA	6.26.5.2 (F)
		Do containers of greater than 2,000 gal (w.c.) have a float gage or other non-venting device?		NA	NA	6.26.5.2 (E)
4	Transfer into Stationary ASME Containers Fixed Maximum Liquid Level gage	Not used during routine transfer operations but used to calibrate other non-venting liquid level gages in the container		NA	NA	6.26.5.2 (C,D)

Note: If the facility does not have a particular feature described in the form, enter "NA" in both the "Yes" and "No" Columns corresponding to the row in item 2.
NA: means not applicable.

If separation distance reductions are intended, checkmarks made in the "No" column of either Form 5.8 or Form 5.9 must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 6.1
Evaluation of Physical Protection and Other Measures

A	B	C	D	E	F
#	Item	Features	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2008 Edition)
1	Lighting‡	Provide lighting For nighttime operations to illuminate storage containers, container being loaded, control valves, and other equipment	x		6.18.5
2	Vehicle impact protection	Protection against vehicular (traffic) impacts on containers, transfer piping and other appurtenances is designed and provided commensurate with the size of vehicles and type of traffic in the facility. (Example protection systems include but not limited to (1) Guard rails, (2) Steel bollards or crash posts, (3) Raised sidewalks.	x		6.9.3.10 and 6.19.3.2
3	Protection against corrosion	Provide protection against corrosion where piping is in contact with supports or corrosion causing substances.	x		6.9.3.11
Complete only 4A or 4B					
4A	Perimeter Fence	Is an industrial type or chain link fence of at least 6 ft high or equivalent protection provided to enclose (all around) container appurtenances, pumping equipment, loading and unloading and container filling facilities?	x		6.18.4.2
		Are at least two means of emergency accesses (gates) from the enclosure provided? **NOTE: Write "N.A." (not applicable) if** (i) The area enclosed is less than 100 ft^2, or (ii) The point of transfer is within 3 ft of the gate, or containers are not filled within the enclosure	x		6.18.4.2 (A)
		Is a clearance of, at least, 3 feet all around to allow emergency access to the required means of egress been provided?	x		6.18.4.2 (B)
	Guard Service	If a guard service is provided, does this service cover the LP-Gas plant and are the guard personnel provided with appropriate LP-Gas related training, per section 4.4 of NFPA 58?	**NA**		6.18.4.3
4B	Lock-in-Place devices	Are Lock-in-Place devices provided to prevent unauthorized use or operation of any container appurtenance, system valves, equipment in lieu of the fence requirements above?	**NA**		6.18.4.2 (C)

Note: Fill only items 1, 2, 3, and 4A or 4B. Indicate with "NA" when not filling the "Yes" or "No" column.
‡ Indicate with "NA" if the facility is not operated at night.
NA: means not applicable.

Form 6.2
Assessment of Sources of Ignition and Adjacent Combustible Materials

A	B	C	D	E
#	Sources of Ignition and Requirements Pertaining to Adjacent Combustible Materials	Is the Facility compliant?		NFPA 58 Section Reference (2008 Edition)
		Yes	No	
1	Are combustible materials, weeds and tall grass not closer than 10 ft. from each container?	x		6.4.5.2
2	Is a distance at least 20 ft. provided between containers and tanks containing flammable liquids with flash point less than 200 °F (ex., gasoline, diesel)?	x		6.4.5.5
3	Are electrical equipment and wiring installed per Code requirements?	x		6.22.2
4	Is open flame equipment located and used according to Code?	x		6.22.3.1
5	Are ignition control procedures and requirements during liquid transfer operations complied with.?	x		7.2.3.2
6	Is an approved, portable, dry chemical fire extinguisher of minimum capacity 18 Lbs. and having a B:C rating provided in the facility?	x		6.25.4.2
7	Is an approved, portable, dry chemical fire extinguisher of minimum capacity 18 Lbs. and having a B:C rating provided on each truck or trailer used to transport portable containers?	x		9.4.7
8	Is the prohibition on smoking within the facility premises strictly enforced?	x		7.2.3.2 (B) & 9.4.10

Note: Insert "NA" in both "Yes" and "No" columns of any items that are not applicable.

Form 6.3

Separation Distances from Containers to Buildings, Property Lines that can be Built upon, Inter-container Distances, and Aboveground Flammable or Combustible Storage Tanks

A	B	C	D	E	F	G
#	Container Size Range in gal (W.C.)	Separation Between a property line, important building or other property and the nearest container which is	Minimum Distance (ft)	Is the Facility compliant?		NFPA 58 Section Reference (2008 Edition)
				Yes	No	
1	501 through 2,000	Above Ground	25	NA		6.3.1 and Table 6.3.1
		Underground or Mounded	10	NA		
		Between containers	3	NA		
2	2,001 through 30,000	Above Ground	50	NA		
		Underground or Mounded	50	NA		
		Between containers	5	NA		
3	30,001 through 70,000	Above Ground	75	NA		
		Underground or Mounded	50	NA		
		Between containers	¼ sum of diameters of adjacent containers	NA		
4	70,001 through 90,000	Above Ground	100	X		
		Underground or Mounded	50	NA		
		Between containers	¼ sum of diameters of adjacent containers	x		
5	All sizes greater than 125 gal	Separation distance between a LP-Gas container and an above ground storage tank containing flammable or combustible liquids of flash points below 200 °F.	20	x		6.4.5.4 and 6.4.5.5

Note: If any of the container sizes indicated in the above form are not present in the facility, then enter "NA" in both "Yes" and "No" Columns.

If the LP-Gas plant is provided with every one of the redundant and fail-safe product control-design equipment indicated in Form 5.8, then the minimum distance in column D of Form 6.3 can be reduced to 10 feet for underground and mounded containers of water capacity 2,001 gal to 30,000 gal.

Form 6.4
Separation Distances between Points of Transfer and other Exposures

A	B		C	D	E	F	G
#	Type of Exposure within or outside the facility boundary		Check if exposure is present	Minimum Distance (ft)	Is the Facility compliant?		NFPA 58 Section Reference (2008 Edition)
					Yes	No	
1	Buildings, mobile homes, recreational vehicles, and modular homes with fire-resistive walls		☐	10	NP		Section 6.5.3 Table 6.5.3
2	Buildings with other than fire resistive walls		☐	25	x		
3	Building wall openings or pits at or below the level of the point of transfer		☐	25	NP		
4	Line of adjoining property that can be built upon		☐	25	x		
5	Outdoor places of public assembly, including school yards, athletic fields, and playgrounds		☐	50	x		
6	Public ways, including public streets, highways, thoroughfares, and sidewalks	From points of transfer in LP-Gas dispensing stations and at vehicle fuel dispensers.	☐	10	NP		
		From other points of transfer	☐	25	x		
7	Driveways		☐	5	x		
8	Mainline railroad track centerlines		☐	25	x		
9	Containers other than those being filled		☐	10	NP		
10	Flammable and Class II combustible liquid dispensers and aboveground and underground containers		☐	20	x		
11	Flammable and Class II combustible liquid dispensers and the fill connections of LPG containers		☐	10	NP		
12	LP-Gas dispensing device located close to a Class I liquid dispensing device.		☐	10	NP		3.9.4.3

Note: Place a checkmark in Column C against an exposure that is present in or around the facility. Fill Columns E or F for only those rows for which there is a checkmark in Column C. **NP**: means not present.

If the facility contains low emission transfer equipment (i.e, all equipment identified in Form 5.9 are installed and are in working order), then the minimum separation distances in column D of Form 6.4 can be reduced to one half of the indicated values.

If the containers in the LP-Gas facility are provided with SPECIAL PROTECTION MEASURES, then continue the analysis below. Otherwise skip Forms 6.5 and 6.6 and go to Form 6.7. Also see Chapter 9.

Form 6.5
Special Protection Measures –Passive Systems

A	B	C	D		E
#	Special Protection Option	Question	Is the Facility compliant?		NFPA 58 Section Reference (2008 Edition)
			Yes	No	
1	Container Insulation	Insulation provided on each of the containers?	NA		6.25.5.1
		Insulation material complies with the requirements of section 6.23.5.1 of NFPA 58?	NA		6.25.5.1 and 6.25.5.2
2	Mounding of containers	Each container in the facility is mounded?	NA		6.25.5.3
		Mounding complies with each requirement under section 6.6.6.3 of NFPA 58.	NA		6.25.5.3
3	Burying of containers	Each container in the facility is buried?	NA		6.25.5.4
		Buried containers comply with each requirement under section 6.6.6.1 of NFPA 58.	NA		6.6.6.1 & 6.25.5.4

Form 6.6
Special Protection Measures –Active Systems

#	Special Protection Option	Question	Is the Facility compliant?		NFPA 58 Section Reference (2008 Edition)
			Yes	No	
1	Water spray systems	Are fixed water spray systems, complying with NFPA 15[1] requirements, used for each container in the facility?	NA		6.25.6.1
		Do fire responsive devices actuate water spray system automatically?	NA		6.25.6.2
		Can the water spray systems be actuated manually also?	NA		6.25.6.2
2	Monitor nozzle systems	Are the monitor nozzles located and arranged so that the water stream can wet the surfaces of all containers exposed to a fire?	x		6.25.6.3
		Can the water stream from a monitor nozzle reach and wet the entire surface of, at least, one half of a length from one end of each of the containers it is designed to protect?	x		6.25.6.3
		Do fixed monitor nozzles comply with NFPA 15[1] requirements?	x		6.25.6.1
		Do fire responsive devices actuate the monitor nozzles?	x		6.25.6.2
		Can the monitor nozzles can be actuated manually also?	x		6.25.6.2

Note: Refer to Chapter 8 for a discussion on NFPA 15 *Standard for Water Spray Fixed Systems for Fire Protection.* NA: Means not applicable.

Form 6.7
Protection Against Vehicular Impact

#	System Protected	Is physical protection provided?		Type of physical protection installed
		Yes	No	
1	Storage containers	x		Bollards/Guard rails
2	Transfer stations	x		Bollards/Guard rails
3	Entry way into the plant	x		Fence/Bollards

Table 7.1
Distances to Various Types of Propane Hazards Under Different Release Models**

Model #	Details of the Propane Release Model Releases from or due to		Vapor Dispersion Distance to LFL (ft)	Explosion Hazard Distance (ft)	Fire Ball Radiation Distance (ft)
1A	Bobtail hose failure. Release of the entire inventory in the hose, quickly.	1" ID x 150 ft hose length	250	110	50
1B		1" ID x 120 ft hose length	230	103	45
1C		1" ID x 75 ft hose length	190	90	40
2a	Release of the inventory in a transfer piping 1" x 30 ft + @ 20 gpm for 10 min., due to failed excess flow valve.		135	120	25
2b	Release of the inventory in a transfer piping 2" x 30 ft + @80 gpm for 10 mins.		230	252	48
2c	Release of the inventory in a transfer piping 2" x 80 ft. @ 70 gpm for 10 mins.		328	235	74
2d	Release of the inventory in a transfer piping 2.5" x 30 ft @80 gpm for 10 mins.		269	252	59
2e	Release of the inventory in a transfer piping 3" x 30 ft + @100 gpm for 10 mins.		312	287	69
2f	Release of the inventory in a transfer piping 3" x 18 ft + @100 gpm for 10 mins.		256	284	55
3	Release from the container pressure relief valve		No ignitable vapor concentration at ground level		
4	Release from a 1" ID x 150 ft transfer piping to a vaporizer and reduced flow from a partially open excess flow valve @ 20 gpm for 10 min.		250	120	50
5	Leak from a corrosion hole in a transfer pipe at a back pressure of 130 psig (corresponding to 80 °F) for 60 min. Hole size is ¼" ID.		110	120	5
6	Release of the entire inventory in a 2" ID x 20 ft., transfer hose.		195	90	40
6a	Release of the entire inventory in a 2.5 inch dia. transfer hose x 16 ft. length		215	98	45
6b	Release of the entire inventory in a 3-inch dia. transfer hose x 12 ft. length		230	100	46
7	Transport hose blow down: Hose size 2" ID, 20 ft length release for 3min., from a Transport after the tank is filled.		25	30	<5
7a	Transport hose blow down: Hose size 2.5" ID, 16 ft length release for 3min., from a Transport after the tank is filled.		25	29	<5
7b	Transport hose blow down: Hose size 3" ID, 16 ft length release for 3min., from a Transport after the tank is filled.		31	36	<5

** Results from models described in Appendix B. The results are rounded to the nearest 5 feet.

Form 7.1
Types of Occupancies[1] Near or Surrounding the LP-Gas Facility

Type of Occupancies	Model # from Table 7.1	Hazard Distance [2] (feet)	Is an Occupancy located within the hazard distance from the Facility?	
			Yes	No
Assembly Occupancies (Places of worship, Libraries, Theaters and Auditoriums, Food or Drink Bars, Sports Stadiums, Amusement Parks, Transportation Centers, etc. with 50 or more people).	2e	284		x
Institutional Occupancies (Elderly Persons Home or Nursing Home, Hospitals, Alcohol & Drug Rehabilitation Centers, Prisons)	0	NA		
Educational Occupancies (Elementary Schools, Day Care facilities, etc).	23	284		x

NOTES: (1) Different types of occupancies are defined in NFPA 5000

(2) Table 7.1 provides a number of scenarios that can result in propane release, and the resulting area exposed for different ignition mechanisms. Determine the scenarios that are applicable to the facility, for the quantities that can be released. Use the hose diameters and length that will be used at the facility if they differ from the ones in Table 7.1 and recalculate the hazard distances using a spreadsheet method that is available at npga.org. Some scenarios may not be applicable to an installation based on other mitigation measures taken, such as a hose management procedure to minimize the possibility of hose failure.

Form 7.2
Exposure to LP-Gas Facility from External Hazards

A	B	C	D
Item #	Type of Neighboring Operation	Hazard exists to the LP-Gas Facility	
		Yes	No
1	Petroleum and other hazardous material storage, wholesale dispensing, etc.		x
2	Metal cutting, welding , and metal fabrication		x
3	Industrial Manufacturing that can pose external hazards		x
4	Ports, rail yards and trans-shipment terminals handling flammable and explosive materials.	x	
5	Other operations that may pose hazards (gasoline and other hazardous material dispensing stations, fertilizer storage, etc).		x

Note: If a particular activity indicated in Column B does not exist, fill both "Yes" and "No" Columns with "NA."

Where a "Yes" has been checked in either Form 7.1 or Form 7.2:

1) **For an existing facility, communicate this information to local emergency responders for inclusion in their emergency planning.**
2) **For a proposed facility, implement the actions indicated in Chapter 9.**

Form 8.1
Data on the Responsible Fire Department

A	B		C
Item #	Data Item		Data Entry
1	Name of the Fire Department (FD).		Grafton Fire Department
2A	Name of the person in the FD assisting with the data acquisition.		Chief Michael E. Gauthier
2B	Position of the person in the FD assisting with the data acquisition.		Fire Chief Forest Warden
3A	Date on which FD data was collected.		June 11, 2015
3B	Name of the person collecting the data.		Robert Palermo
4	Number of firefighters on duty at any time.		65 firefighters (FFs) on call
5	Average number of firefighters available for response.		25 and up to 65
6A	Number of firefighters qualified to	"Firefighter I" level.	25
6B		"Firefighter II" level.	25
7A	Number of firefighters who would	respond on the first alarm to the facility.	2 FFs – weekday (daytime [still alarm]); 8 FFs – weekday (daytime [all call]); 7 FFs – weekday nighttime/weekends [still alarm]; 15 FFs – weekday nighttime/weekends [all call]
7B		respond on the first alarm and who are qualified to the operations level requirements of NFPA 472 or local requirements	4 FFs
7C		respond on the first alarm with specific knowledge and training on the properties of LP-Gas and LP-Gas fires.	1 FF – weekday (daytime [still alarm]); 4 FFs – weekday (Daytime [all-call]); 4 FFs – weekday nighttime/weekends [still alarm]; 8 FFS – weekday nighttime/Weekends [all call]
8A	Number of fire apparatus that have the capability to deploy a 125 gpm hose line supplied by onboard water for at least 4 minutes, and	that are in service in the department.	5
8B		that would respond on a first alarm.	1

Note: From 8.1 was completed based on input from Chief Michael Gauthier of the Grafton Fire Department.

Form 8.2

Response Time data for the Fire Departments

A	B	C	D	E
Company or Department	Time in Minutes for			
	Alarm Receipt & Handling	Turnout	Travel	Total Time
Grafton, MA FD Station#2 only (still alarm only)	1 minute	4 minutes	3 minutes	8 minutes
				0
				0
				0
				0
				0
				0
				0

Notes: Number in Column E = Sum of numbers from Columns B through D.

Form 8.2 was completed based on input from Chief Michael Gauthier of the Grafton Fire Department.

This form contains formulas that will automatically calculate results based on the values entered in the related cells. To activate the calculations, click in another number field, such as one in Column D.

Form 8.3
Water Flow Rate and Total Water Volume Required to Cool Containers Exposed to a Fire

A	B	C	D	E	F	G	H
Item #	ASME Container Size	Total Surface Area of each Container	Surface Area of each container to be Cooled	Water flow rate required per container	Number of containers of the size indicated	Total Water flow rate required‡	Total volume of water required for 10 min
	(gallons)	(ft^2)	(ft^2)	(gpm)		(gpm)	(gal)
1	500	86	43	10.8		0.0	0.0
	1,000	172	86	21.5		0.0	0.0
	2,000	290	145	36.3		0.0	0.0
	4,000	374	187	46.8		0.0	0.0
	6,500	570	285	71.3		0.0	0.0
	9,200	790	395	98.8		0.0	0.0
	12,000	990	495	123.8		0.0	0.0
	18,000	1,160	580	145.0		0.0	0.0
	30,000	1,610	805	201.3		0.0	0.0
	45,000	2,366	1,183	295.8		0.0	0.0
	60,000	3,090	1,545	386.3		0.0	0.0
	80,000	4,098	2,049	512	3	1,536	1,536
	90,000	4,600	2,300	575.0		0	0
2a	Calculate water flow rate for container protection		Rounding up [13 * 125 = 1,625]			1,536	
2b	Water flow rate rounded up to nearest multiple of 125					1,625	
3	Water for firefighter protection if required					250	
4	Total water flow rate and volume					1,875	18,750

Note: Column D = (1/2) x Column C Column E = 0.25 (gpm/ft^2) x Column D ;
Column G = Column F x Column E Column H = 10 x Column G
Line 2, Column G and Column H are the sum of numbers in each row above line 2 of each column.
Line 4, Column G and Column H are the sum of numbers in rows 2 and 3.

‡ Consider only 3 containers for water supply evaluations even if the number of containers in a group is more than 3.

1 ASME container approximate dimensions

This form contains formulas that will automatically calculate results based on the values entered in the related cells. To activate the calculations, click in another number field, such as one in Column F.

The total water requirement for the facility is indicated in item 4, column G (water flow rate) and column H (total water volume or quantity) of Form 8.3. If multiple groups of containers are present in the facility, repeat the calculations in Form 8.3 for each group of containers. The total water requirement for the facility is the largest value for any single group of containers.

Form 8.4
Evaluation of Water Availability in or Near the LP-Gas Facility

A	B	C	D		
Item #	Water from	Available?	Quantitative information (1),(2)		
1	Public supply or from another piped-in supply through one or more fire hydrants in or near the facility	☒ Yes ☐ No	Hydrant data	Distance from Facility gate (feet)	Available water flow rate from all hydrants[(1)] (gpm)
			Hydrant 1	600	3,660
			Hydrant 2	445	
			Hydrant 3	0	
2	A nearby static water source (stream, pond, lake, etc).	☒ Yes ☐ No	Distance to water source = 700 feet Time to set up relay = min. Rate of delivery = gpm		
3	Only through mobile water tanker shuttle.	☐ Yes ☒ No	Time to set up shuttle = min. Sustainable flow rate = gpm		

NOTE: (1) Obtain the flow rate in each hydrant from the local municipal water authority or the entity that supplies water to the hydrant or conduct a test to determine total available flow rate.

Mr. Matt Pearson from the Grafton Water District was contacted on May 4, 2015 to obtain information on hydrant flow and water supply test(s) on Westboro Road and noted that the recent fire hydrant testing conducted by MPE, Inc. was the most up to date information that was available for the water main on Westboro Road.

(2) Fire hydrant retesting was conducted again by MPE, Inc. on June 4, 2015 which confirmed the previous water testing results and indicated that the available water supply at 20 psi was 4,050 gpm (see Appendix D of FSA Report dated June 17, 2015 for MPE, Inc. hydrant testing reports).

1. **For an existing facility, communicate this information to local responders for inclusion in their emergency planning.**
2. **For a proposed new facility, refer to Chapter 9**

Form 9.1
Analysis Summary on Product Control and Local Conditions of Hazard

A	B	C	D	E
Item #	CHAPTER Title	Section & Title	Reference FORM #	Number of "No" checked§
1	Product Control Measures in Containers & Transfer Piping	5.1: Product Control in Containers	5.1 or 5.2 or 5.3 or 5.4	0
		5.2 Product Control in Transfer Piping	5.5	0
			5.6	0
			5.7	0
			5.8	0
			5.9	0
2	Analysis of Local Conditions of Hazard	6.1 Physical Protection Measures	6.1	0
		6.2 Ignition Source Control	6.2	0
		6.3.1 Separation distances; Container and outside exposures	6.3	0
		6.3.2 Separation distances; Transfer points and outside exposures	6.4	0
		6.4 Special Protection Measures	6.5	0
			6.6	0

§ The number of "No" for Forms from Chapter 5 is the difference between the required number of appurtenances according to NFPA 58-2008, and a lesser number found to be actually installed on the container or the transfer piping.

If in any row of Column E ("No") of Form 9.1, the entry number is greater than zero, the proposed LP-Gas facility is not in compliance with the 2008 NFPA 58 Code requirements for product control appurtenances or other safety measures. The design of the proposed facility must be modified to conform to the Code requirements. In addition, the following items should be noted.

- If there are any "No" checks in Form 6.3, then the separation distance requirements for containers are not satisfied. An option that may be considered is the reduction in separation distance to 10 feet for underground and mounded containers by providing "Redundant and Fail-Safe Product Control Measures." In this case, complete Form 9.4, below to ensure that each requirement of "Redundant and Fail-Safe Product Control Measures" is provided.

- If there are any "No" checks in Form 6.4, then the separation distance requirements for transfer points are not satisfied. In this case, relocate the transfer points so that the separation distances conform to the code requirements or provide the Low Emission Transfer Equipment. Complete Form 9.5 below and ensure that all requirements for Low Emission Transfer Equipment are fulfilled.

Form 9.2
Analysis Summary on Exposure from and to the LP-Gas Facility

A	B	C	D	E
Item #	**CHAPTER Title**	**Section & Title**	**Reference FORM #**	**Number of "Yes" Checked**
1	Exposure to and from Other Properties	7.1 Exposure to off-site properties and persons from in-plant propane releases	7.1	0
		7.2 Exposure to propane facility from external events.	7.2	1

If the entry number in column E ("Yes"), Form 9.2 corresponding to Form 7.1 is greater than zero, consider one or more of the following design alternatives.

1) Consider moving the container or the transfer point to a different location, if possible and space exists, so that the property or the person is beyond the hazard distance.
2) Provide "Redundant and Fail-safe Product Control Measures". Complete Form 9.4 to ensure compliance.
3) Institute other technical measures such as installing gas and flame detectors (connected to facility shut down systems), sounding alarm outside facility premises, etc.
4) Institute administrative controls such as additional training for personnel, more frequent inspection of hoses and transfer piping, etc.

If the entry number in column E ("Yes"), Form 9.2 corresponding to Form 7.2 is greater than zero, consider one or more of the following design alternatives.

1) Implement procedures to monitor neighboring activity.
2) Install means in the adjacent plant to shut down the LP-Gas plant in case emergency in that plant.

Form 9.3
Analysis Summary on Fire Department Evaluations

A	B	C	D	E	F
Item #	CHAPTER Title	Section & Title	Reference FORM #	Number "zeroes" entered in Column C, Lines 6 through 8 of Form 8.1	Number of "Yes" checked in Column C of Form 8.4
1	Fire department capability, adequacy of water supply and Emergency Planning	8.1 Data on the Fire Department	8.1	0	—
		8.2 Fire response water needs and availability	8.4	—	1

If the entry number in row 1, Column E of Form 9.3 is greater than zero, consider one or more of the following design alternatives.

1) Discuss with the local Fire Department the needs of the LP-Gas facility and the evaluation results on the capability and training inadequacies of the Department.
2) Consider developing a cadre of personnel within the LP-Gas facility to respond to emergencies.
3) Institute container special protection system based on active protection approaches or passive approaches. Complete Form 9.6 and Form 9.7 below.

If the entry number in row 2, Column F of Form 9.3 is equal to zero, consider one or more of the following design alternatives.

1) Provide special protection (other than water spray or monitor systems) to containers, satisfying the requirements of section 6.25.5 of NFPA 58, 2008 edition. Complete Form 9.6 to ensure compliance.
2) Consider implementing the various options indicated in Table 9.1.

Form 9.4
Redundant and Fail-Safe Design for Containers

A	B		C	D	E	F
Item #	Description		Features	Proposed for the facility?		NFPA 58 Section Reference (2008 Edition)
				Yes	No	
1	Container Sizes for which the appurtenances are provided		Appurtenances and redundant fail-safe equipment and Low Emission transfer lines are provided for each container of water capacity 2,001 gal to 30,000 gal	NA		6.26.4 and 6.26.5
2	Liquid or Vapor Withdrawal (1-1/4 in. or larger)		Internal Valve with integral excess flow valve or excess flow protection	x		6.26.3.1
			Positive Shutoff Valve installed as close as possible to the Internal Valve	x		6.26.3.4
3	Liquid or Vapor Inlet		Internal Valve with integral excess flow valve or excess flow protection or Back Flow Check valve	x		6.26.3.5
			Positive Shutoff Valve installed as close as possible to the Internal Valve or the back flow check valve			6.26.3.5
4	Railcar Transfer	Flow Into or Out of Railroad tank car	Emergency Shutoff Valve installed in the transfer hose or the swivel-type piping at the tank car end.	x		6.18.2.6 (1) and 6.26.4.1
		Flow Only Into railroad tank car	Emergency shutoff valve or backflow check valve installed in the transfer hose or the swivel-type piping at the tank car end.	x		6.18.2.6 (2) and 6.26.4.1
5	Cargo Tank Transfer		Protection provided in accordance with 6.26.4.1	x		6.26.4.1
6	Automatic closure of all primary valves (IV & ESV) in an Emergency		By fire actuation	x		6.26.4.2
			In the event of a hose pull-away due to vehicle motion	x		6.26.4.2
7	Manually operated remote shutdown of IV and ESV		Remote shutdown station within 15 ft of the point of transfer?	x		6.26.4.3 (A)
			Another remote shutdown station between 25 ft and 100 ft of the transfer point?	x		6.26.4.3 (B)
			Shutdown stations will shut down electrical power supply, if any, to the transfer equipment and primary valves?	x		6.26.4.3
			Signs complying with the requirements of 6.26.4.3 (C) provided?	x		6.24.4.3 (C)

Note: If your facility does not have a rail terminal, enter "NA" in both the "Yes" Column and the "No" Column in item 4 of the form in the railroad tank car row. Similar option is also available if there is no cargo tank vehicle transfer station. NA: Means not applicable.

Form 9.5
Low Emission Transfer Equipment

A	B	C		D	E	F
Item #	Description	Features		Proposed for the facility?		NFPA 58 Section Reference (2008 Edition)
				Yes	No	
1	Transfer into Cylinders or ASME Containers on Vehicles	Delivery Nozzle and Filer Valve-Max. Liquid Release after transfer of 4 cc.	Fixed Maximum Liquid Level Gauge not used during transfer operations	NA		6.26.5.1 (B)
2	Transfer into Stationary ASME Containers Delivery valve and nozzle combination	During product transfer or post transfer uncoupling of the hose, liquid product volume released to the atmosphere	Does not exceed 4 cc (0.24 in^3) from a hose of nominal size 1 in or smaller	NA		6.26.5.2(A)
			Does not exceed 15 cc (0.91 in^3) from a hose of nominal size larger than 1 in.	NA		6.26.5.2 (B)
3	Transfer into Stationary ASME Containers Maximum filling limit	Do containers less than 2,001 gal (wc) have an overfilling prevention device or another approved device?		NA		6.26.5.2 (F)
		Do containers greater than 2,000 gal (wc) have a float gauge or other non-venting device?		x		6.26.5.2 (E)
4	Transfer into Stationary ASME Containers Fixed Maximum Liquid Level gauge	Not used during routine transfer operations but may be used in calibrating other non-venting liquid level gauges in the container		x		6.26.5.2 (C,D)

Note: If the facility does not have a particular feature described in the form, enter "NA" in both the "Yes" and "No" Columns corresponding to its row in item 2.

Form 9.6
Special Protection Measures –Passive Systems

A	B	C	D		E
Item #	Special Protection Option	Question	Proposed for the facility?		NFPA 58 Section Reference (2008 Edition)
			Yes	No	
1	Container Insulation	Insulation provided on each of the containers?	NA		6.25.5.1
		Insulation material complies with the requirements of section 6.25.5.1 of NFPA 58?	NA		6.25.5.1 and 6.25.5.2
2	Mounding of containers	Each container in the facility is mounded?	NA		6.25.5.3
		Mounding complies with each requirement under section 6.6.6.3 of NFPA 58.	NA		6.25.5.3
3	Burying of containers	Each container in the facility is buried?	NA		6.25.5.4
		Buried containers comply with each requirement under section 6.6.6.1 of NFPA 58.	NA		6.6.6.1 & 6.25.5.4

Form 9.7
Special Protection Measures –Active Systems

Item #	Special Protection Option	Question	Is the Facility compliant?		NFPA 58 Section Reference (2008 Edition)
			Yes	No	
1	Water spray systems	Are fixed water spray systems, complying with NFPA 15 requirements, used for each container in the facility?	NA		6.25.6.1
		Do fire responsive devices actuate water spray system automatically?	NA		6.25.6.2
		Can the water spray systems be actuated manually also?	NA		6.25.6.2
2	Monitor nozzle systems	Are the monitor nozzles located and arranged so that the water stream can wet the surfaces of all containers exposed to a fire?	x		6.25.6.3
		Can the water stream from a monitor nozzle reach and wet the entire surface of, at least, one half of a length from one end of each of the containers it is designed to protect?	x		6.25.6.3
		Do fixed monitor nozzles comply with NFPA 15 requirements?	x		6.25.6.1
		Do fire responsive devices actuate the monitor nozzles?		x	6.25.6.2
		Can the monitor nozzles be actuated manually also?	x		6.25.6.2

Equivalent Protection to a Water Supply for Industrial and Bulk Facilities

In the case where water supply is not available in or near the LP-Gas facility, or is inadequate or is prohibitively expensive to connect to a public or private water supply hydrant, alternative methods for providing protection should be considered. In lieu of providing a water supply, several alternatives are indicated in Table 9.1, which can offer an equivalency to a water supply system.

The intent of the controls identified in Table 9.1 is to maintain the entire system as a gas tight entity. These methods include reducing the service life of equipment, increasing the design pressure rating of the system beyond the requirements of NFPA 58, or providing early detection and isolation of the system to ensure product control. This list is not exhaustive and is not ranked in an order of priority.

Table 9.1
Suggested Alternative Methods for Industrial and Bulk Plants that do not pose a hazard but lack a water supply

Item #	Possible options to implement when adequate water supply is not available
1	Reduce the service life of hoses.
2	Increase frequency of equipment inspection.
3	Establish a service life program for the maintenance of the container pressure relief devices. This could include the installation of a listed multiple port valve and certifying that the relief devices are properly set and maintained every 5 to 10 years.
4	Increase the strength of the piping and fitting systems.
5	Install emergency shutoff valves in conjunction with container internal valves.
6	Install emergency shutoff valves downstream of transfer pump outlets, and upstream of the vapor and liquid valves at the bulkhead.
7	Install pneumatic tubing along the plant boundary to serve as a perimeter fire detection system. This would provide protection of the plant against exposure fires.
8	Provide optical flame detection or linear heat detection, or a gas detection system connected to an isolation valve installed downstream of every liquid and vapor nozzle on the container. This system could also be monitored to send a signal to an alarm company that notifies the Fire Department of an event.
9	Increase the separation distances of internal plant exposures to the container. These exposures would include a site dumpster, idle or waste pallets and combustibles, and increasing the parking distances between the bobtails and transports in relation to the container.
10	Relocate overhead power lines away from all container and cylinder storage areas to protect against ignition in the event of a line dropping due to wind or power pole impact.
11	Eliminate all combustible vegetation within 30 feet of the LP-Gas container. This can be accomplished using gravel, or paving the site yard.
12	Install tanks using the mounding or burial method.

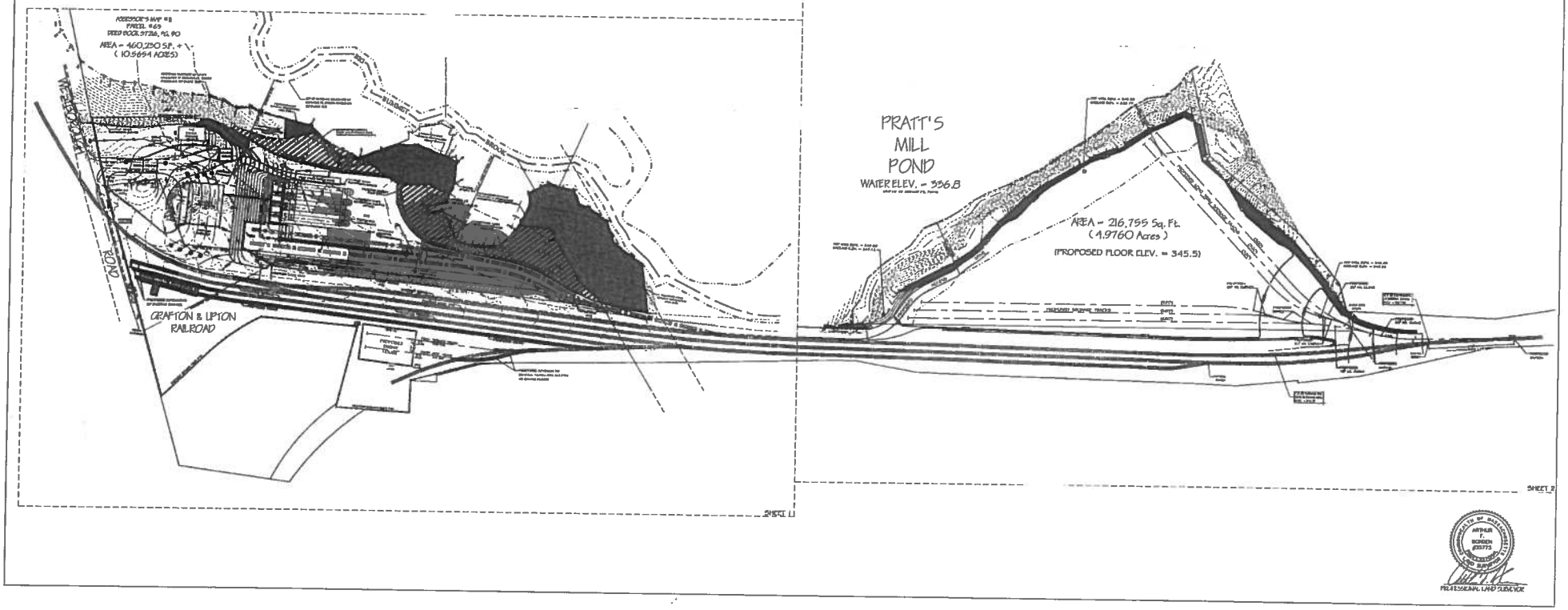
Appendix B –
Arthur F. Borden & Associates, Inc., Site Plan
May 7, 2015

Grafton and Upton Railroad

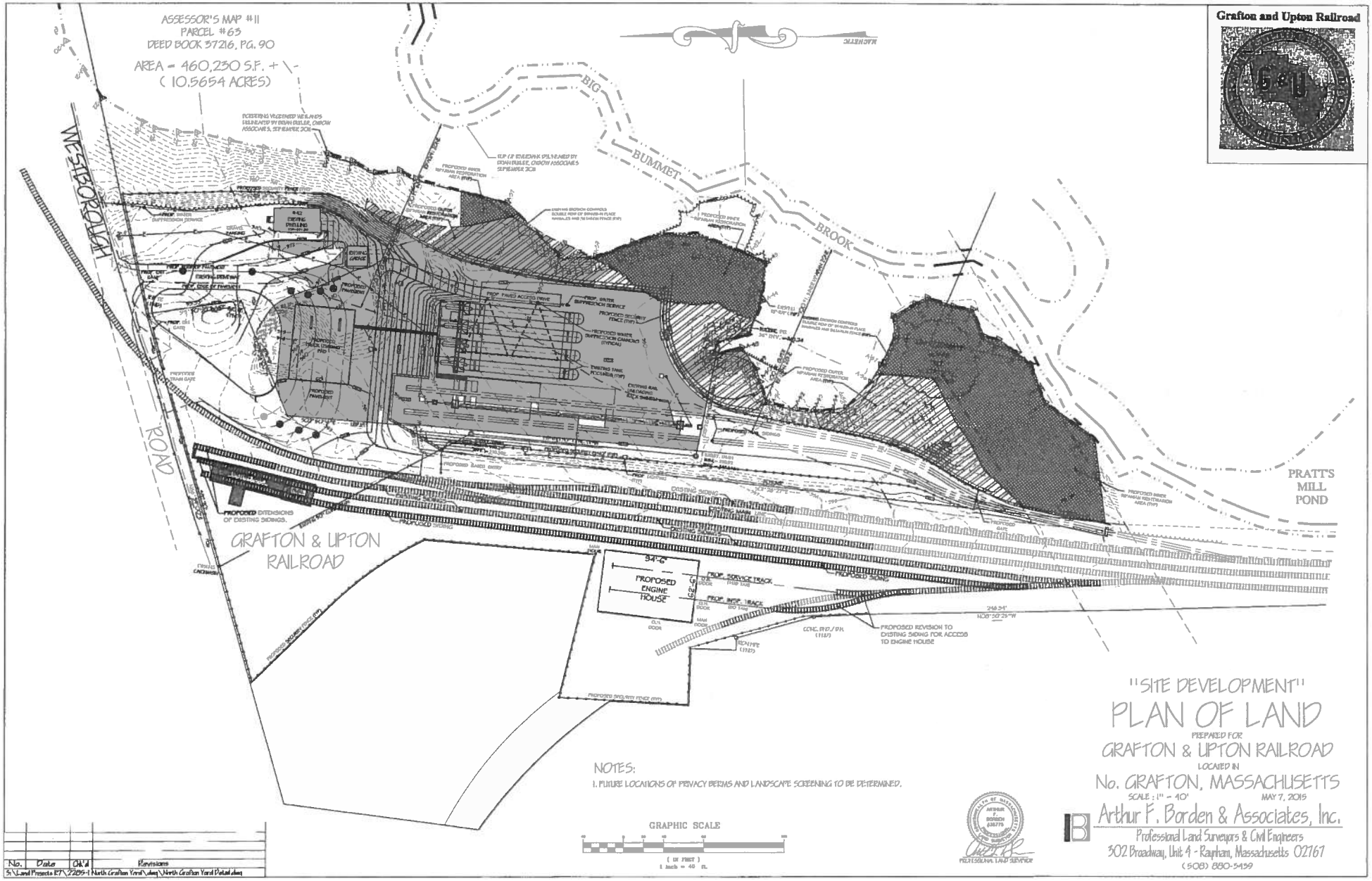
GRAFTON & UPTON RAILROAD
I-90 INTERMODAL TERMINAL
42 WESTBORO ROAD | GRAFTON, MASS.

SCALE : 1" = 80' MAY 7, 2015

Arthur F. Borden & Associates, Inc.
Professional Land Surveyors & Civil Engineers
302 Broadway, Unit 4 - Raynham, Massachusetts 02767
(508) 880-3439



ARTHUR F. BORDEN #35773 REGISTERED PROFESSIONAL LAND SURVEYOR



NOTES:

1. FUTURE LOCATIONS OF PRIVACY BERMS AND LANDSCAPE SCREENING TO BE DETERMINED.

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

"SITE DEVELOPMENT"

PLAN OF LAND

PREPARED FOR
GRAFTON & UPTON RAILROAD
LOCATED IN
No. GRAFTON, MASSACHUSETTS
SCALE : 1" = 40' MAY 7, 2015

Arthur F. Borden & Associates, Inc.
Professional Land Surveyors & Civil Engineers
302 Broadway, Unit 4 - Raynham, Massachusetts 02767
(508) 880-5439

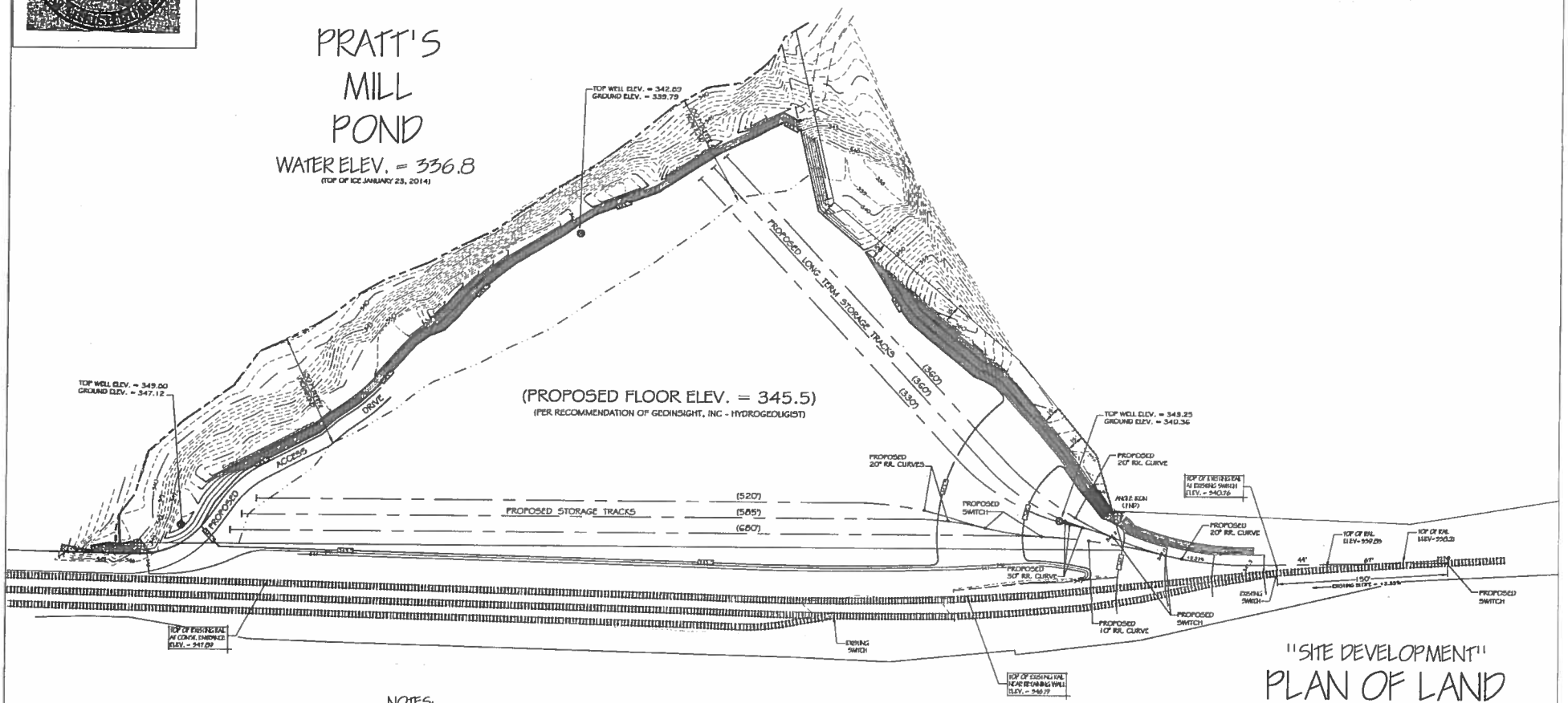
No.	Date	Ck'd	Revisions

S:\Land Projects RT\2205-1 North Grafton Yard\dwg\North Grafton Yard Plot.dwg

Grafton and Upton Railroad

PRATT'S MILL POND

WATER ELEV. = 336.8
(TOP OF ICE JANUARY 23, 2014)



NOTES:

1. EXISTING SITE CONDITIONS TO BE RE-GRADED TO PROVIDE A TABLE ELEVATION OF 345.5
2. UPON COMPLETION OF TABLE ELEVATION, RAIL SPURS ARE TO BE INSTALLED.
3. FUTURE LOCATIONS OF PRIVACY BERMS AND LANDSCAPE SCREENING TO BE DETERMINED.

GRAPHIC SCALE
(IN FEET)
1 inch = 40 ft.

No.	Date	CK'd	Revisions

S:\Land Projects\R7\2205-1 North Grafton Yard\dwg\North Grafton Yard Plot.dwg

"SITE DEVELOPMENT"

PLAN OF LAND

PREPARED FOR
GRAFTON & UPTON RAILROAD
LOCATED IN
No. GRAFTON, MASSACHUSETTS
SCALE : 1" = 40'
MAY 7, 2015

Arthur F. Borden & Associates, Inc.
Professional Land Surveyors & Civil Engineers
302 Broadway, Unit 4 - Raynham, Massachusetts 02767
(508) 880-5459

Appendix C –
Geotechnical Engineering Report on
Foundations and Tank Piers

Geotechnical Consultants, Inc.
(508)229-0900 FAX (508)229-2279

14 January 12013

Grafton & Upton Railroad
50 Westborough Road
Grafton, MA 01536

Attention: Mr. Bob Bowey

RE: Results of Core Samples - Compressive Strength Tests
Propane Facility – 50 Westborough Road
Grafton, Massachusetts
GCI Project No. 2123508

Dear Mr. Bowey:

As requested, we have performed concrete testing for the above referenced project. All tests were made in general conformance with ASTM C42 *Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.* In general, four core locations were randomly selected throughout the existing footings and four samples were procured for laboratory compressive strength testing.

Based on the cores obtained on 08 January 2013, the in-situ concrete strength ranged between 3,330 and 3,880 psi. See attached results for specific test locations. Based on the test results, the 28 day strength exceeds the required design strength.

We trust the foregoing and attached are consistent with our discussions. Should you have any questions, please do not hesitate to call us.

Sincerely,
GEOTECHNICAL CONSULTANTS, INC.

COMMONWEALTH OF MASSACHUSETTS
RICHARD PIZZI
32644
REGISTERED PROFESSIONAL ENGINEER

Richard Pizzi, P.E.

RP/pgsj
Attachments

GEOTECHNICAL CONSULTANTS, INC.

201 BOSTON POST ROAD WEST
MARLBOROUGH, MA 01752

GCI Testing
Telephone: (508)229-0900
FAX: (508)229-2279

CONCRETE INSPECTION REPORT

Grafton & Upton Railroad
50 Westboro
Grafton MA 01536

Job No: 2123508
Project: Propane Facility 50 Westborough Rd.
Location: Grafton MA
Series ID#: 12249

TARGET STRENGTH:	CONCRETE SUPPLIER:	ASTM:
3000	Dauphinais	Concrete- C-39, C-143, C-231 Grout- C-1019 Mortar- C-109 Drilled Cores - C-42

SAMPLES: 4 **SLUMP:** **LOCATION:** Footing # 1 - Cast on 10-23-2012

AIR TEMP: F **CONC TEMP:** F

AIR CONTENT: % **TRUCK NO.**

TIME CAST:

LAB NO.	SIZE	AREA (SQ.IN.)	DATE CAST	DATE TESTED	AGE DAYS	STRENGTH (PSI)	TYPE OF FRACTURE	REMARKS
52855	Core	11.04	10/23/2012	1/10/2013	79	3500		
52856	Core	11.04	10/23/2012	1/10/2013	79	3770		
52857	Core	11.04	10/23/2012	1/10/2013	79	3880		
52858	Core	11.04	10/23/2012	1/10/2013	79	3650		

REMARKS:
Four cores were procured on 1-08-13 from the footing cast on 10-23-12. Two cores were taken from each end of the footing. Length/Diameter corrections have been applied in accordance with ASTM C42.

GEOTECHNICAL CONSULTANTS, INC.

INSPECTED BY: OTHER

REVIEWED BY: Paul Sousa

GEOTECHNICAL CONSULTANTS, INC.

201 BOSTON POST ROAD WEST
MARLBOROUGH, MA 01752

GCI Testing
Telephone: (508)229-0900
FAX: (508)229-2279

CONCRETE INSPECTION REPORT

Grafton & Upton Railroad
50 Westboro
Grafton MA 01536

Job No: 2123508
Project: Propane Facility 50 Westborough Rd.
Location: Grafton MA
Series ID#: 12250

TARGET STRENGTH:	CONCRETE SUPPLIER:	ASTM:
3000	Dauphinais	Concrete- C-39, C-143, C-231 Grout- C-1019 Mortar- C-109 Drilled Cores - C-42

SAMPLES: 4 **SLUMP:** **LOCATION:** Footing # 2 - Cast on 11-2-2012

AIR TEMP: F **CONC TEMP:** F

AIR CONTENT: % **TRUCK NO.**

TIME CAST:

LAB NO.	SIZE	AREA (SQ.IN.)	DATE CAST	DATE TESTED	AGE DAYS	STRENGTH (PSI)	TYPE OF FRACTURE	REMARKS
52860	Core	11.04	11/2/2012	1/10/2013	69	3490		
52861	Core	11.04	11/2/2012	1/10/2013	69	3500		
52862	Core	11.04	11/2/2012	1/10/2013	69	3570		
52863	Core	11.04	11/2/2012	1/10/2013	69	3330		

REMARKS:
Four cores were procured on 1-08-13 from the footing cast on 10-23-12. Two cores were taken from each end of the footing. Length/Diameter corrections have been applied in accordance with ASTM C42.

GEOTECHNICAL CONSULTANTS, INC.

INSPECTED BY: OTHER

REVIEWED BY: Paul Sousa

Geotechnical Consultants, Inc.
(508)229-0900 FAX (508)229-2279

18 December 2012

First Colony Development
929 Boston Post Road East
Marlborough, MA 01752

Attention: Mr. John Mercier

RE: Summary Letter - Pad Preparation
Proposed Propane Facility
42 Westborough Road - Grafton, MA
GCI Project No. 2123508

Dear Mr. Mercier:

In accordance with our agreement, Geotechnical Consultants, Inc. has performed construction materials testing for the pad preparation at the above captioned site. Please find attached copies of our daily field reports and laboratory test results.

The pad preparation included excavation of unsuitable material and the placement and compaction of imported material used as structural backfill. The pad preparation was completed in conformance with the recommendations and specifications as shown on the latest LPG Ventures drawings dated September 2012.

We trust the foregoing and attached are sufficient for your immediate needs and appreciate the opportunity to work with you on this project.

Sincerely,
GEOTECHNICAL CONSULTANTS, INC.

COMMONWEALTH OF MASSACHUSETTS
RICHARD PIZZI
32644
REGISTERED PROFESSIONAL ENGINEER

Richard Pizzi, P.E.

RP/prr
attachments

GEOTECHNICAL CONSULTANTS, INC.
201 Boston Post Road West
Marlborough, MA 01752
Telephone: (508) 229-0900

Project:	42 Westborough Rd. – Propane Facility	**Date:**	10-9-12
Location:	Grafton, MA	**Job#:**	2123508
Contractor:	First Colony	**Weather:**	Clear, 60's

Daily report

PURPOSE: To observe and monitor for suitable soil and soil conditions.

WORK: The proposed foundation for the tank pad was excavated to foundation grade and observed to be in existing virgin material. The mentioned material was proof-rolled and sample was taken to be verified for gradation.

Reviewed By: PS	**ENGINEER: PJ**

GEOTECHNICAL CONSULTANTS, INC.
201 Boston Post Road West
Marlborough, MA 01752
Telephone: (508) 229-0900

Project:	42 Westborough Rd. – Propane Facility	**Date:**	10-10-12
Location:	Grafton, MA	**Job#:**	2123508
Contractor:	First Colony	**Weather:**	Clear, 60's

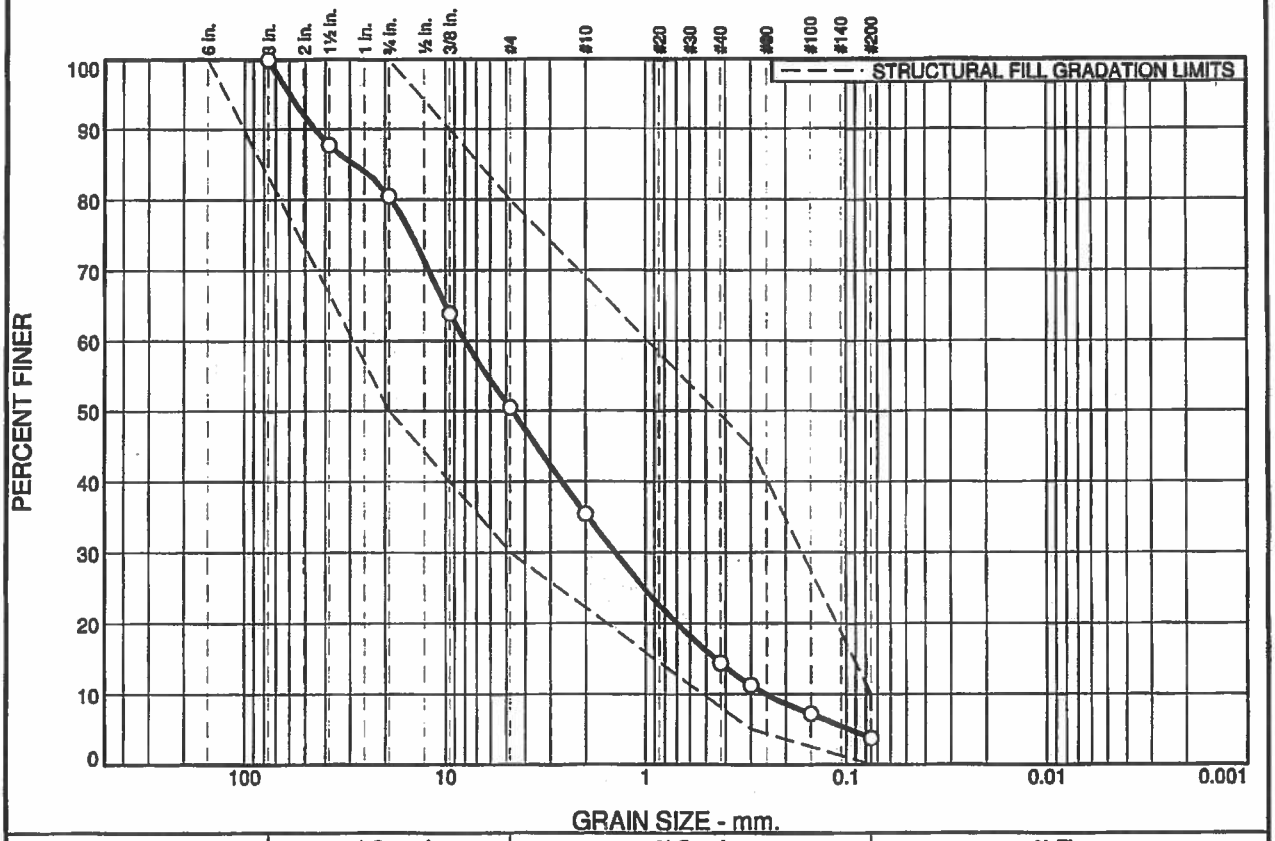
Daily report

PURPOSE: To observe and monitor for suitable soil and soil conditions

WORK: The proposed foundation for the tank pad was excavated to foundation grade and observed to be in existing virgin material. Imported material was placed at 6" above the existing, already sampled material. This was also sampled to be verified for gradation and observed as it was compacted.

Reviewed By: PS	**ENGINEER: PJ**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	19.5	30.0	15.1	21.0	10.6	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
1.5"	87.7		
3/4"	80.5	50.0 - 100.0	
3/8"	63.9		
#4	50.5	30.0 - 80.0	
#10	35.4		
#40	14.4		
#50	11.2	5.0 - 45.0	
#100	7.2		
#200	3.8	0.0 - 10.0	

* STRUCTURAL FILL GRADATION LIMITS

Material Description

Well-graded gravel with sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= GW AASHTO=

Coefficients

D_{85}= 28.3586 D_{60}= 7.9955 D_{50}= 4.6273
D_{30}= 1.4281 D_{15}= 0.4505 D_{10}= 0.2515
C_u= 31.79 C_c= 1.01

Date Tested: 10/18/12 **Tested By:** PJ

Remarks

Sample No.: 2745 **Source of Sample:** **Date Sampled:** 10/09/12
Location: On Site Material **Elev./Depth:**
Checked By: PS **Title:**

Geotechnical Consultants, Inc.

Marlborough, MA

Client: First Colony Development
Project: 42 Westborough Rd, Grafton, MA

Project No: GCI#2123508 **Figure**

COMPACTION TEST REPORT

Project No.: GCI#2123508 **Date:** 10/18/12
Project: 42 Westborough Rd, Grafton, MA

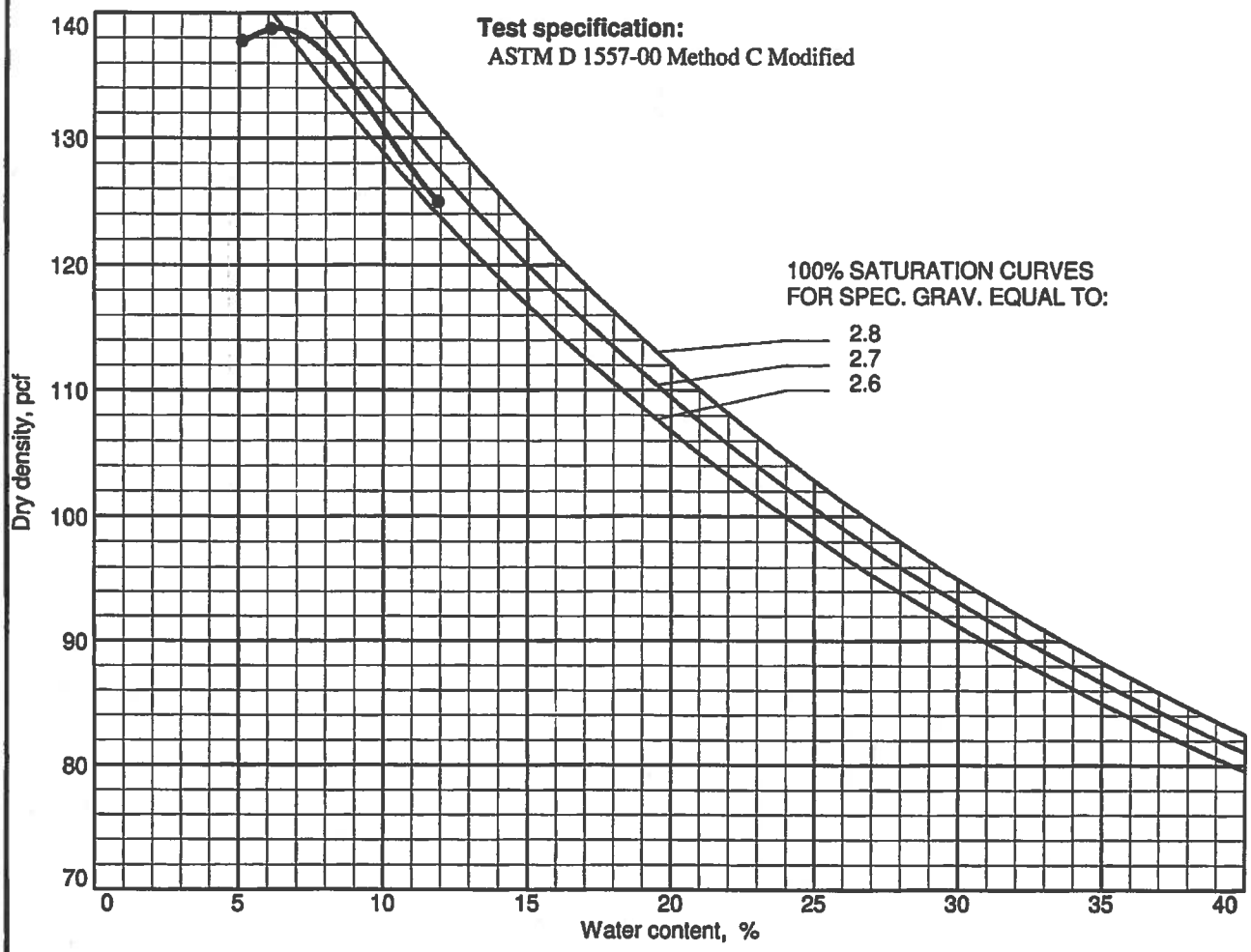
Location: On Site Material
Elev./Depth: **Sample No.** 2745
Remarks:

MATERIAL DESCRIPTION

Description: Well-graded gravel with sand

Classifications - **USCS:** GW **AASHTO:**
Nat. Moist. = **Sp.G. =**
Liquid Limit = **Plasticity Index =**
% > 3/4 in. = 19.5 % **% < No.200 =** 3.8 %

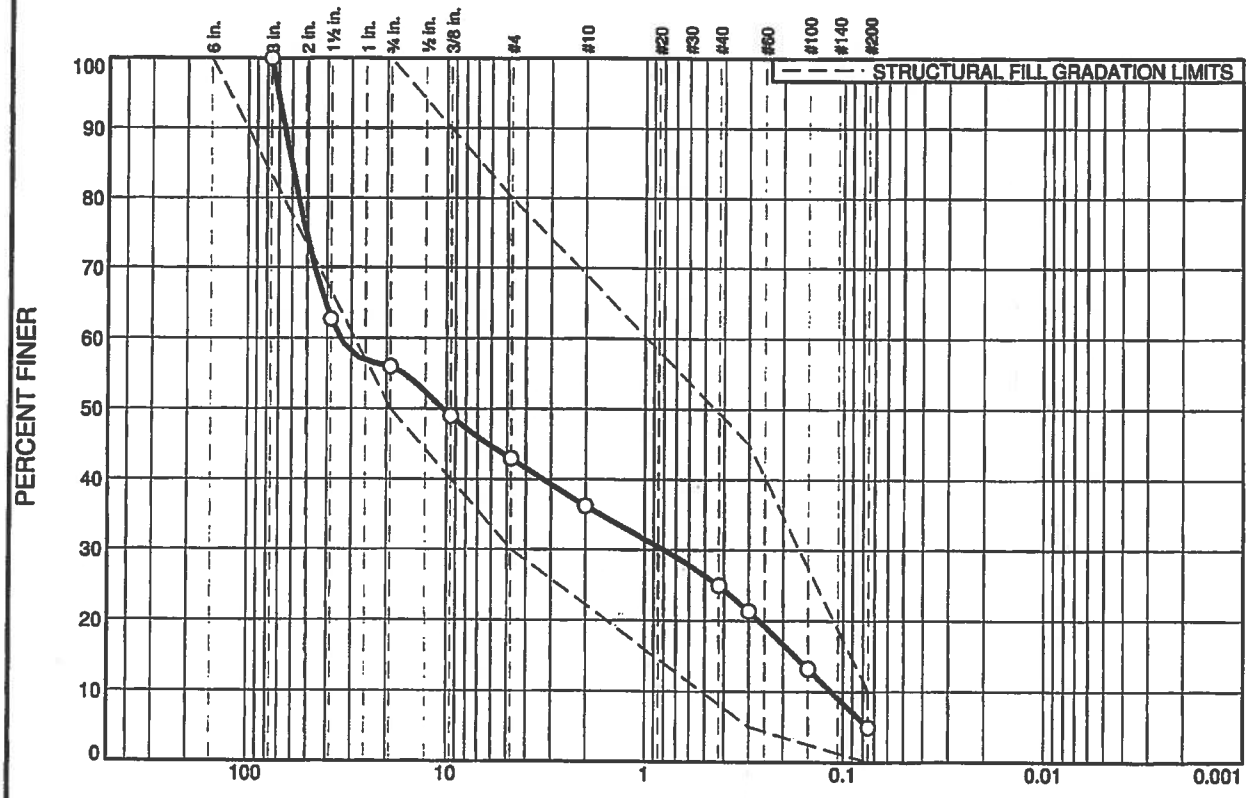
TEST RESULTS
Maximum dry density = 139.0 pcf
Optimum moisture = 6.5 %



Figure

Geotechnical Consultants, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	44.0	13.0	6.8	11.3	19.9	5.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
1.5"	62.7		
3/4"	56.0	50.0 - 100.0	
3/8"	49.0		
#4	43.0	30.0 - 80.0	
#10	36.2		
#40	24.9		
#50	21.3	5.0 - 45.0	
#100	13.2		
#200	5.0	0.0 - 10.0	

* STRUCTURAL FILL GRADATION LIMITS

Material Description

Poorly graded gravel with silt and sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= GP-GM AASHTO=

Coefficients

D_{85}= 60.3715 D_{60}= 34.2388 D_{50}= 10.4035
D_{30}= 0.7984 D_{15}= 0.1743 D_{10}= 0.1148
C_u= 298.27 C_c= 0.16

Date Tested: 10/18/12 **Tested By:** PJ

Remarks

Sample No.: 2746 **Source of Sample:** **Date Sampled:** 10/11/12
Location: Imported Material **Elev./Depth:**
Checked By: PS **Title:**

Geotechnical Consultants, Inc.

Marlborough, MA

Client: First Colony Development
Project: 42 Westborough Rd, Grafton, MA

Project No: GCI#2123508 **Figure**

COMPACTION TEST REPORT

Project No.: GCI#2123508 **Date:** 10/22/12
Project: 42 Westborough Rd, Grafton, MA

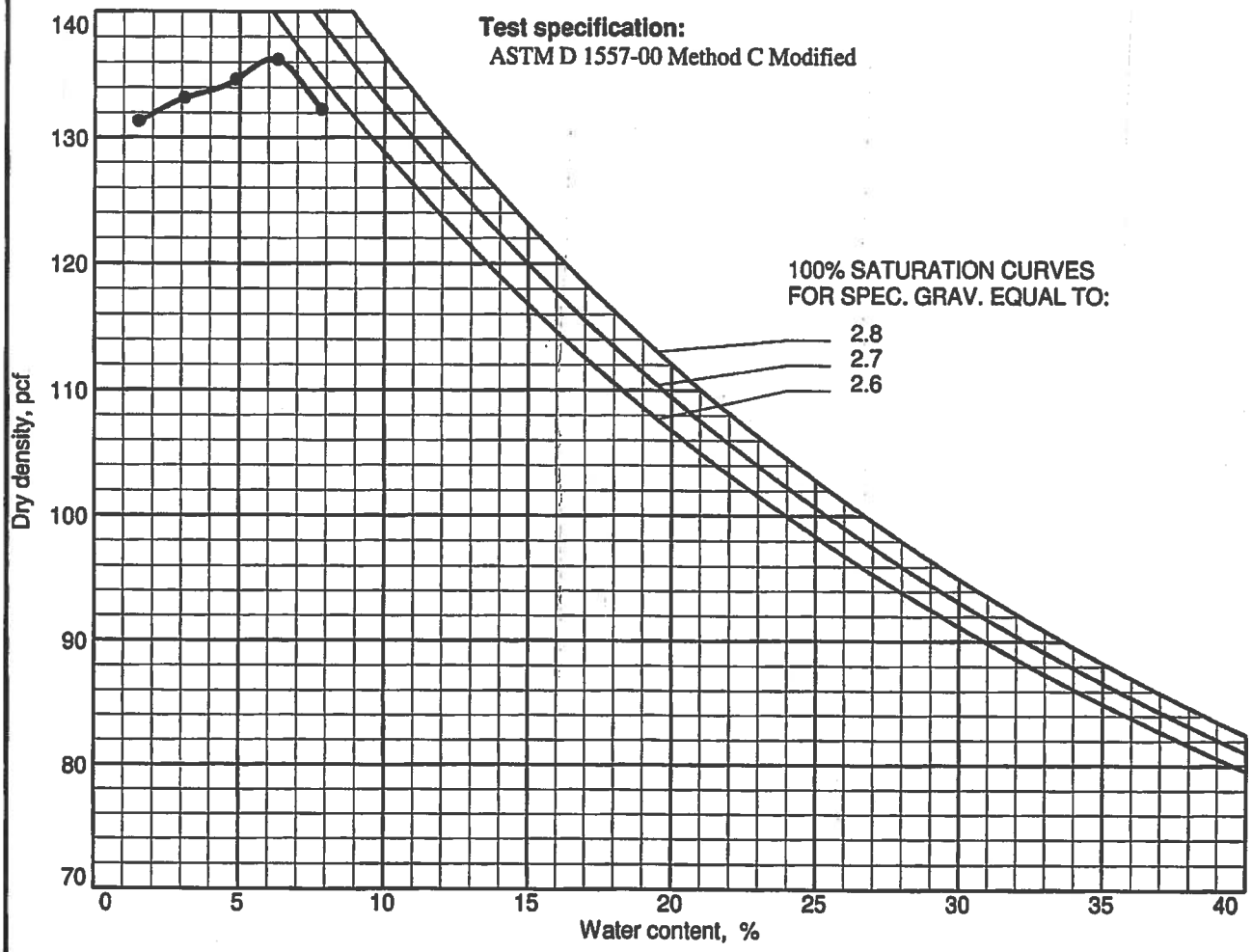
Location: Imported Material
Elev./Depth: **Sample No.** 2746
Remarks:

MATERIAL DESCRIPTION

Description: Poorly graded gravel with silt and sand

Classifications - **USCS:** GP-GM **AASHTO:**
Nat. Moist. = **Sp.G. =**
Liquid Limit = **Plasticity Index =**
% > 3/4 in. = 44.0 % **% < No.200 =**

TEST RESULTS
Maximum dry density = 136.5 pcf
Optimum moisture = 6.0 %



Figure

Geotechnical Consultants, Inc.

Appendix D –
Hydrant Testing by MPE, Inc.
Along 42 Westboro Road, Grafton, MA

MPE, Inc.
Design & Construction Services

10 Pendleton Drive
P.O. Box 259
Hebron, CT 06248
(860) 228-3636 • (800) 833-6734
FAX (860) 228-8574

Grafton & Upton Railroad
c/o Dr. Robert Palermo
42 Westboro Road
Grafton, MA 01519

June 12, 2015

Re: 2015 Hydrant Flow Test - Rail Yard - Grafton, MA

A second hydrant flow test was conducted using town hydrants on Westboro Road in the area of the rail yard.

The flow hydrant was a new hydrant recently installed with the new 8" main that ended just after the hydrant. From this point the existing 6" water main runs up past the gauge hydrant to a point at the corner of North Main Street.

This area has a good town grid of 8" and 12" mains that feed the 6" main in front of the rail yard from both directions.

Both 2-½" hydrant butts were flowed initially but with such high pressures the flow out of the outlet was too turbulent to get accurate pitot readings. The hydrant was shut down and a play pipe was installed on each 2-½" hydrant outlet. The hydrant was reopened and the play pipes helped smooth out the water stream allowing for an accurate pitot gauge reading. There is a very strong water supply in this area that is adequate to feed four (4) water cannons a total of 1,875 gallons @100 psi.

Robert Ceppi
Fire Protection Engineer #33625
MA Sprinkler Contractor Lic. #801

COMMONWEALTH OF MASSACHUSETTS
ROBERT J. CEPPI
Fire Protection
No. 33625
REGISTERED
PROFESSIONAL ENGINEER

MPE, Inc.
Design and Construction Services
10 Pendleton Drive
P.O. Box 259
Hebron CT 06248
(860) 228-3636 • (800) 833-6734
FAX (860) 228-8574

FLOW TEST

TEST No.: 1 CLIENT: G + U R.

LOCATION:
STREET 42 Westboro RD
CITY/STATE Grafton MA
VICINITY OF: Railroad Yard

DATE: 6/4/15 TIME: 830 DAY OF WEEK: THURSDAY

PRESSURE READINGS:
HYDRANT No.: 2 ELEV.: 0
~~RISER~~ No.:
STATIC PRESSURE (BEFORE FLOW TEST): 133 psi
RESIDUAL PRESSURE (FLOWING): 115 gpm
STATIC PRESSURE (AFTER FLOW TEST): 133 psi

FLOW READINGS:
HYDRANT No.: 1 ELEV.: 0
* SIZE OF OUTLET: 1¾ x 2 ~~RISER~~ No.:
COEF. 1

PITOT TUBE PRESSURE (psi)	EQUIVALENT FLOW (gpm)
74	788
74	788

TOTAL DISCHARGE: 1576

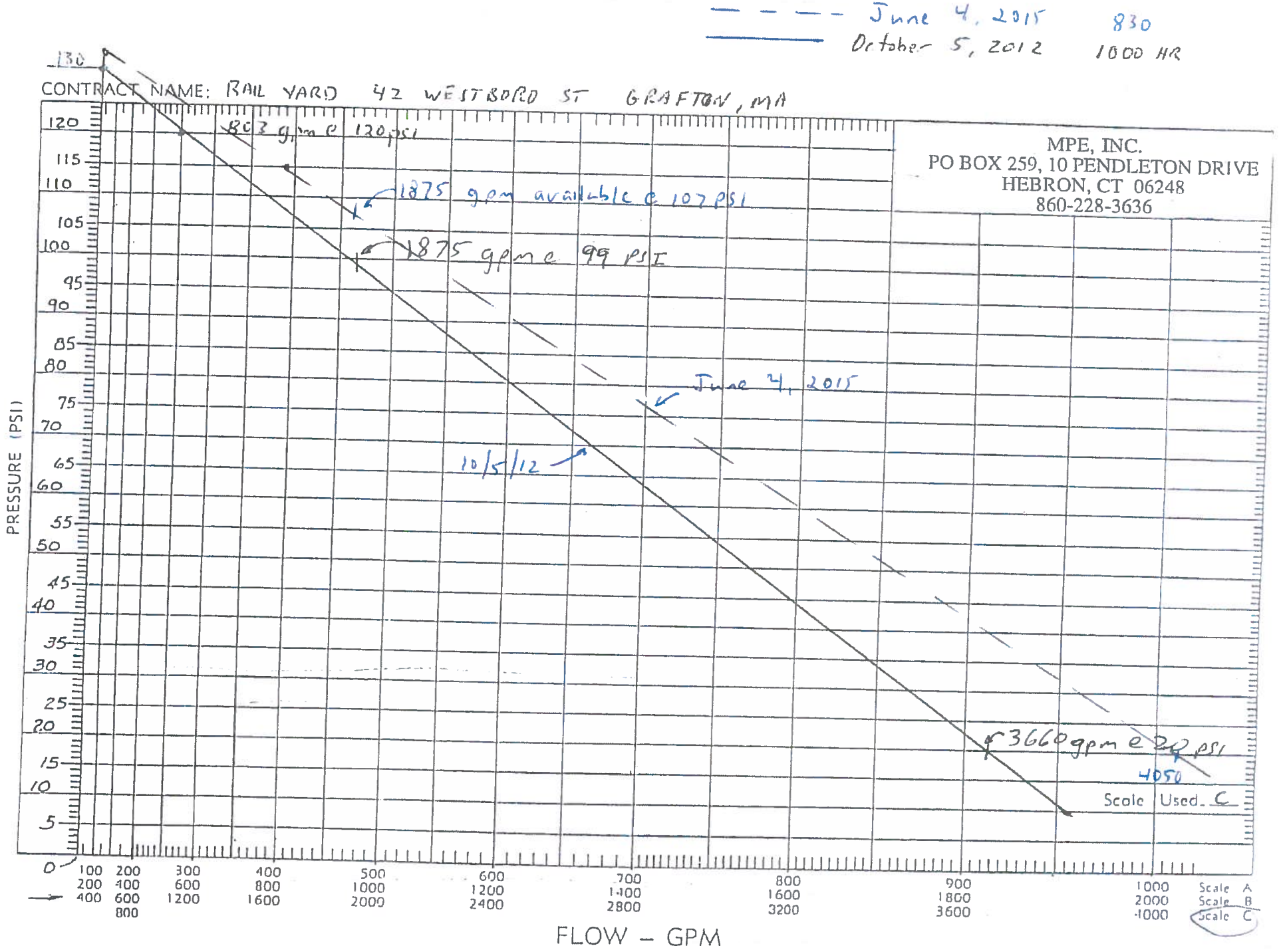
AVAILABLE FLOW at 20 psi: 4050 gpm

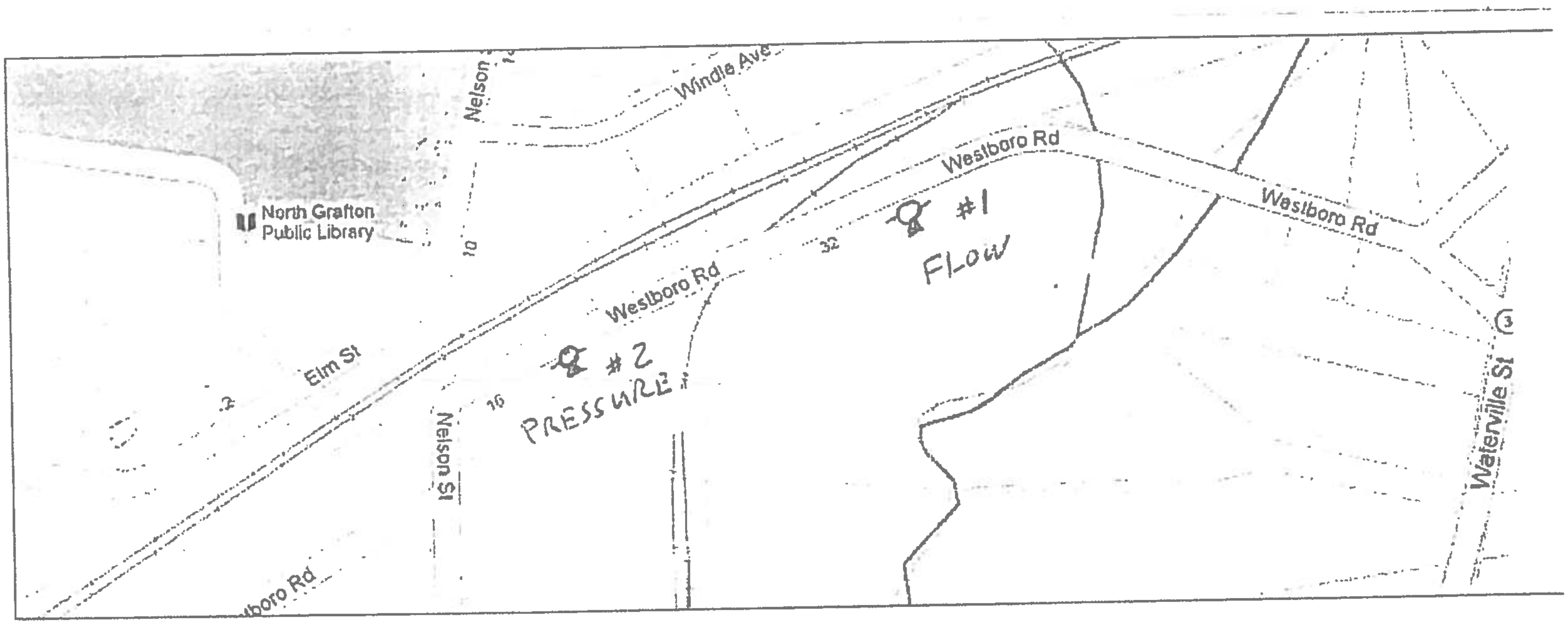
TEST CONDUCTED BY: ROBERT CEPPI

TEST WITNESSED BY: STEVE from Water Dept

SKETCH AND/OR COMMENTS

* USED A PLAYPIPE ON A 2½" OUTLETS TO SMOOTH OUT STREAM
SEE ATTACHED SKETCH


June 4, 2015
October 5, 2012
830
1000 HR
CONTRACT NAME: RAIL YARD 42 WESTBORO ST GRAFTON, MA
803 gpm @ 120 psi
1875 gpm available @ 107 PSI
1875 gpm @ 99 PSI
June 4, 2015
10/5/12
3660 gpm @ 20 psi
4050
Scale Used. C
MPE, INC.
PO BOX 259, 10 PENDLETON DRIVE
HEBRON, CT 06248
860-228-3636
PRESSURE (PSI)
FLOW – GPM
Scale A
Scale B
Scale C


North Grafton
Public Library
Nelson
Windle Ave
Westboro Rd
Westboro Rd
Westboro Rd
#1
FLOW
32
#2
PRESSURE
Elm St
16
Nelson St
Waterville St
10

Appendix E –
Design Basis for Fire Cannon Water Suppression System

MPE, Inc.
Design & Construction Services

10 Pendleton Drive
P.O. Box 259
Hebron, CT 06248
(860) 228-3636 • (800) 833-6734
FAX (860) 228-8574

FIRE PROTECTION NARRATIVE

GRAFTON & UPTON RAILROAD
PROPANE RAIL FACILITY

42 WESTBORO ROAD
GRAFTON, MA

WATER CANNONS FOR
COOLING PROPANE TANKS

PREPARED BY

ROBERT J. CEPPI PE
MA PE LIC. # 33625
MA SPRINKLER CONTRACTOR LIC. # 801

June 19, 2015

FIRE PROTECTION NARRATIVE

MPE has proposed the use of water cannons at Grafton & Upton Railroad Propane Facility to be used to cool the four 80,000 gallon LP Tanks. Some of the cannons could also serve a dual purpose of providing a water supply to the rail cars as well as the truck loading area.

A new 8" fire protection water main will be connected to the town's water main in the street. It will run into the facility and split to feed two hydrants on each side that will have water cannons mounted to them. These hydrants will also be available for hose streams.

The fire mains will be 8" cement lined ductile iron class 52 pipe. The hydrants used will match the hydrants the town uses. The monitors will be model PC60 which will provide a straight stream of approximately 135 ft. flowing 480 gpm with inlet pressure of 100 psi. See attached data sheets for the monitor nozzle.

I have also attached a conceptual plan showing the water cannons and how they will provide coverage for cooling the LPG tanks.

Robert J. Ceppi
Fire Protection Engineer #33625
MA Sprinkler Contractor Lic. #801

MODEL PC-40, 50, 60 and 85 NOZZLES

The versatile PC-40, 50, 60 and 85 nozzles are valuable for fighting tank and spill fires, fires in sludge or separator pits and ponds, pump manifold pits and large dike areas. They can be mounted permanently near process units in refineries as well as on docks and loading racks, or they can be mounted with monitors on foam trucks, trailers, fire boats, or on tankers for cargo space protection. See Figure 6 for photo of PC-40 through PC-85 nozzle.

A standard 2½" female swivel on the inlet permits quick connection to a fixed outlet or adjustable monitor.

The PC-40, 50 and 60 series nozzles are constructed of brass (chrome plating optional) or painted aluminum. An "A" suffix after the basic model number denotes aluminum construction. The PC-65 nozzle is available in aluminum only. See Table 2 for model designations, materials and weights. See Figure 6 for outline dimensions.

A lever action manually operated spray control handle allows the operator to change instantaneously, and without shutting down, to any one of seven variations in pattern, ranging from full spray to straight stream.

These nozzles are also available with hydraulically operated spray control. The hydraulic actuator has 1/8" NPT connecting ports. All brass models have a manual override spray control arm. Aluminum hydraulically operated spray models do not have manual override controls, since they are normally used on mobile equipment tower trucks.

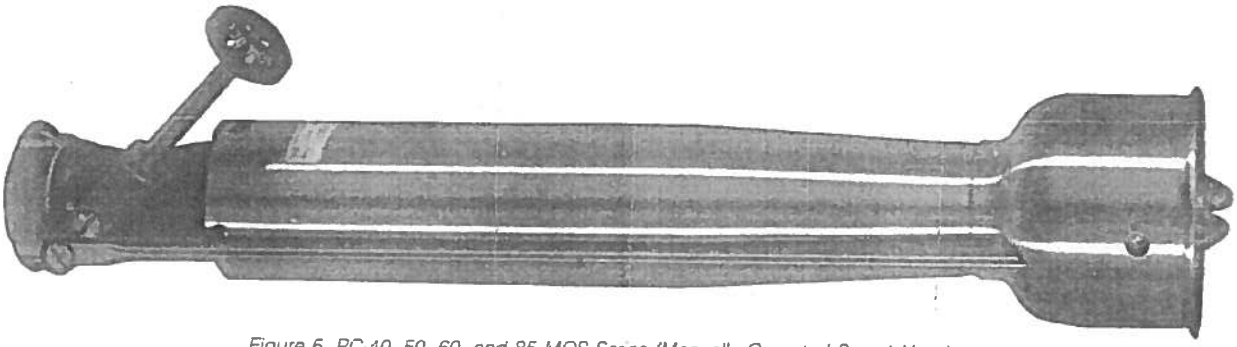


Figure 6. PC-40, 50, 60, and 85 MOS Series (Manually Operated Spray) Nozzles

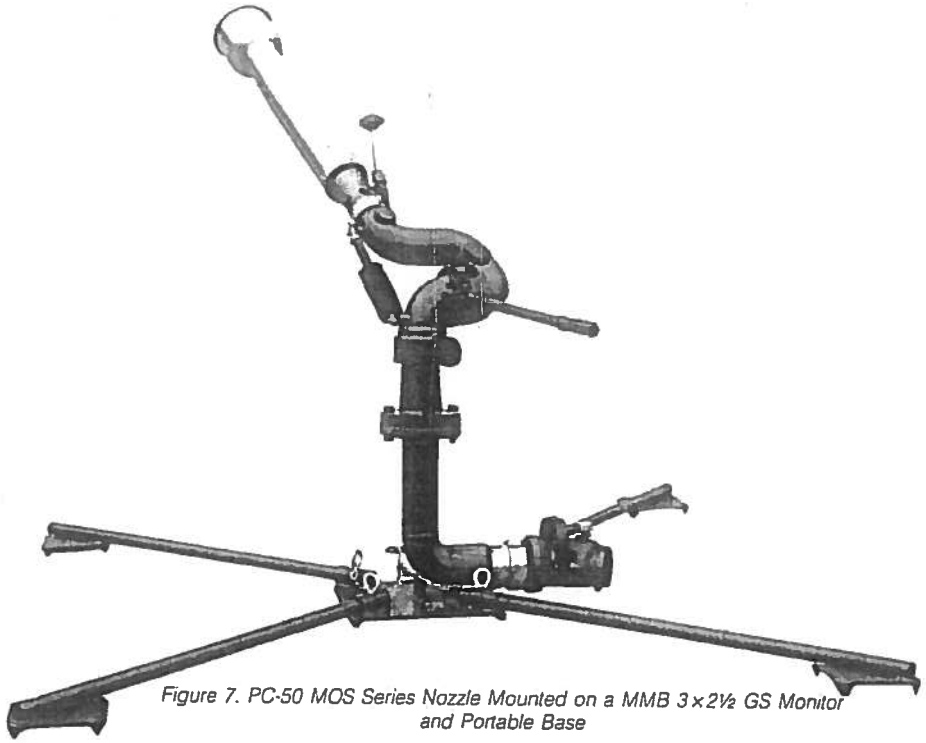


Figure 7. PC-50 MOS Series Nozzle Mounted on a MMB 3×2½ GS Monitor and Portable Base

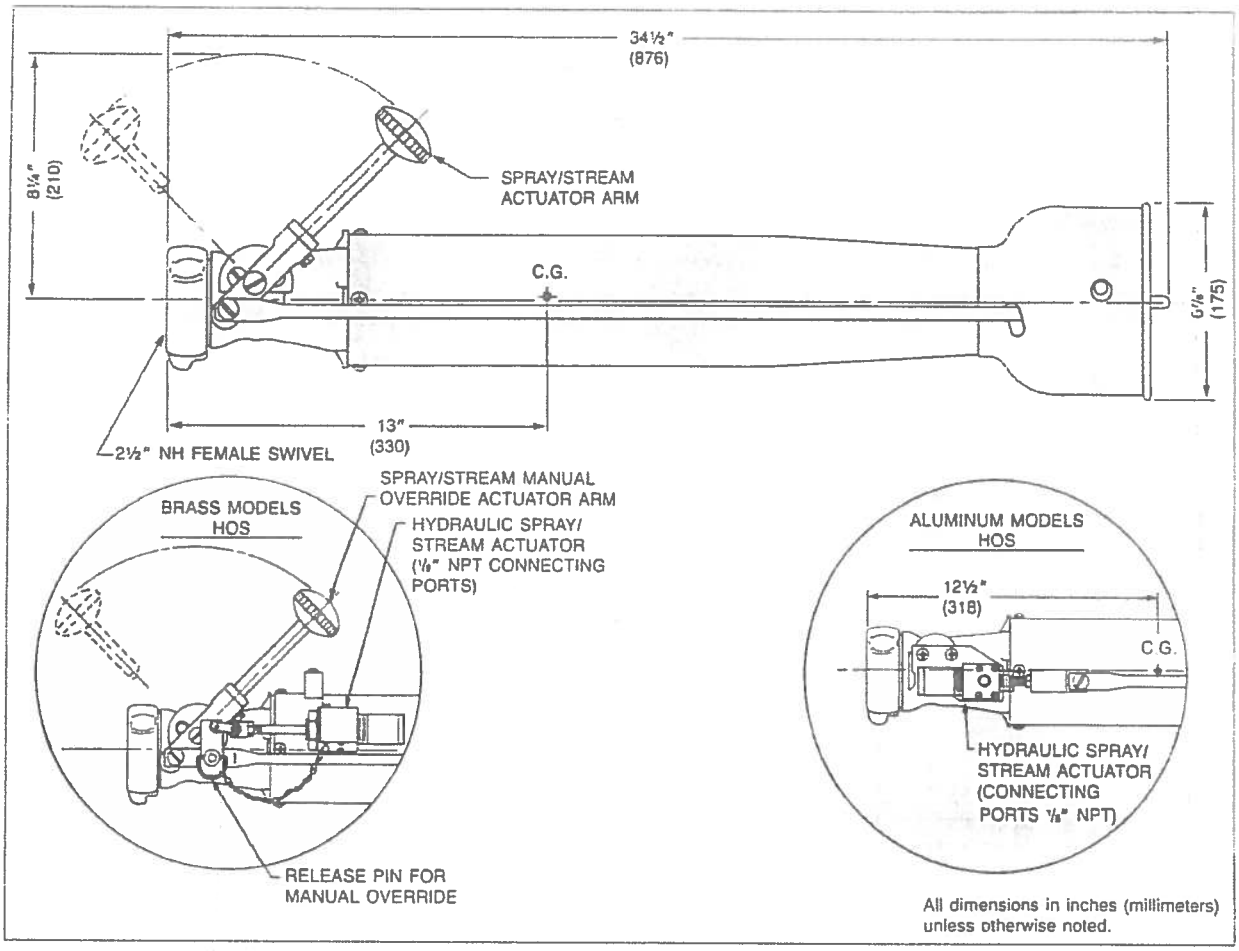


Figure 8. PC-40, 50, 60, and 85 MOS Series (Manually Operated Spray) Nozzles. HOS (Hydraulically Operated Spray) Nozzles Shown in Inserts — Outline Dimensions

Table 2. PC-40, 50, 60, and 85 Series Nozzles — Model Designations, Materials, and Weights

Model	Materials	Weight Lbs (Kgs)
PC-40 MOS PC-50 MOS PC-60 MOS	Brass and stainless steel, chrome plating optional	22½ (10.2)
PC-40 HOS PC-50 HOS PC-60 HOS	Brass and stainless steel, chrome plating optional	25 (11.3)
PC-40A MOS PC-50A MOS PC-60A MOS	Aluminum and stainless steel	14 (6.4)
PC-40A HOS PC-50A HOS PC-60A HOS	Aluminum and stainless steel	15½ (7)
PC-85A MOS	Aluminum and stainless steel	14 (6.4)

Suffix A denotes aluminum nozzle.

MOS denotes manually operated spray pattern adjustment.

HOS denotes hydraulically operated spray pattern adjustment.

MODEL PC-90, 100, 110, 150, 200, 250, AND 400 NOZZLES

When larger capacity monitor-mounted nozzles are required, National offers a complete range from 900 to 4000 gpm (3407-15,142 lpm) nominal flow rates at 150 psi (1034 kPa) inlet pressure. All of these nozzles have flanged inlet connections for direct mounting on compatible National Foam monitors. Although these nozzles are nominally rated at 150 psi (1034 kPa), they are suitable for operation at pressures from 50 to 200 psi (345 to 1379 kPa).

The PC-90 through 200 series are available with either manually operated or hydraulically operated spray control. Any PC-90 through 400 series nozzle is available with straight stream. Models PC-90, 100 and 110 nozzles are also available in aluminum construction, which is denoted by an "A" suffix after the basic model number.

Table 3. PC-90, 100, 110, 150, 200, 250, and 400 Series Nozzles — Model Designations, Materials, and Weights

Model	Materials	Weight Lbs (Kgs)
PC-90 STRM PC-100 STRM PC-110 STRM	Brass and stainless steel	32 (14.5)
PC-90 MOS PC-100 MOS PC-110 MOS	Brass and stainless steel	35 (15.9)
PC-90 HOS PC-100 HOS PC-110 HOS	Brass and stainless steel	38 (17.3)
PC-90A STRM PC-100A STRM PC-110A STRM	Aluminum and stainless steel	12 (5.5)
PC-90A MOS PC-100A MOS PC-110A MOS	Aluminum and stainless steel	15 (6.8)
PC-90A HOS PC-100A HOS PC-110A HOS	Aluminum and stainless steel	19 (9)
PC-150 STRM PC-200 STRM	Brass and stainless steel	64 (29)
PC-150 MOS PC-200 MOS	Brass and stainless steel	75 (34)
PC-150 HOS PC-200 HOS	Brass and stainless steel	88 (40)
PC-250 STRM	Brass and stainless steel	175 (80)
PC-400 STRM	Brass and stainless steel	290 (132)

Suffix A denotes aluminum nozzle.

STRM denotes straight stream.

MOS denotes manually operated spray pattern adjustment.

HOS denotes hydraulically operated spray pattern adjustment.

Most PC series nozzles are U.S. Coast Guard approved for use on shipboard foam systems. Consult National's Engineering Department for additional details.

See Figures 10, 13, and 15 for photos, and Figures 9, 11, 12, 14 and 16 for outline assemblies for these series of nozzles. Table 3 gives model designations, materials, and weights for PC-90 through PC-400 series nozzles.

NOZZLE STREAM HEIGHT AND THROW RANGE

Occasionally it becomes necessary to throw a foam stream from a ground-level monitor over the wall of a product storage tank to extinguish a fire. In these cases, the maximum stream height and throw range are important parameters to know. Table 4 indicates characteristics of foam stream heights assuming a ground-mounted monitor nozzle using 45° angle of elevation and still air conditions. Figures 17 and 18 give nozzle characteristics.

Table 4. Nozzle Stream Height Characteristics PC-31, 40, 50, and 60 Series Nozzles at 45° Angle of Elevation

Nozzle Series	Nozzle Inlet Pressure PSI (kPa)	Max. Throw Range Ft (M)	Max. Height of Stream Ft (M)	Range at Max. Height Ft (M)
PC-31	100 (690) 150 (1034) 200 (1379)	95 (28.9) 105 (32) 115 (35.1)	35 (10.7) 40 (12.2) 45 (13.7)	70 (21.3) 90 (27.4) 100 (30.5)
PC-40	100 (690) 150 (1034) 200 (1379)	115 (35.1) 125 (38.1) 135 (41.1)	55 (16.8) 60 (18.3) 70 (21.3)	70 (21.3) 80 (24.4) 90 (27.4)
PC-50	100 (690) 150 (1034) 200 (1379)	130 (39.6) 145 (44.2) 160 (48.7)	60 (18.3) 70 (21.3) 85 (25.9)	80 (24.4) 90 (27.4) 100 (30.5)
PC-60	100 (690) 150 (1034) 200 (1379)	135 (41.1) 150 (45.7) 165 (50.3)	60 (18.3) 80 (24.4) 95 (28.9)	85 (25.9) 95 (28.9) 105 (32)

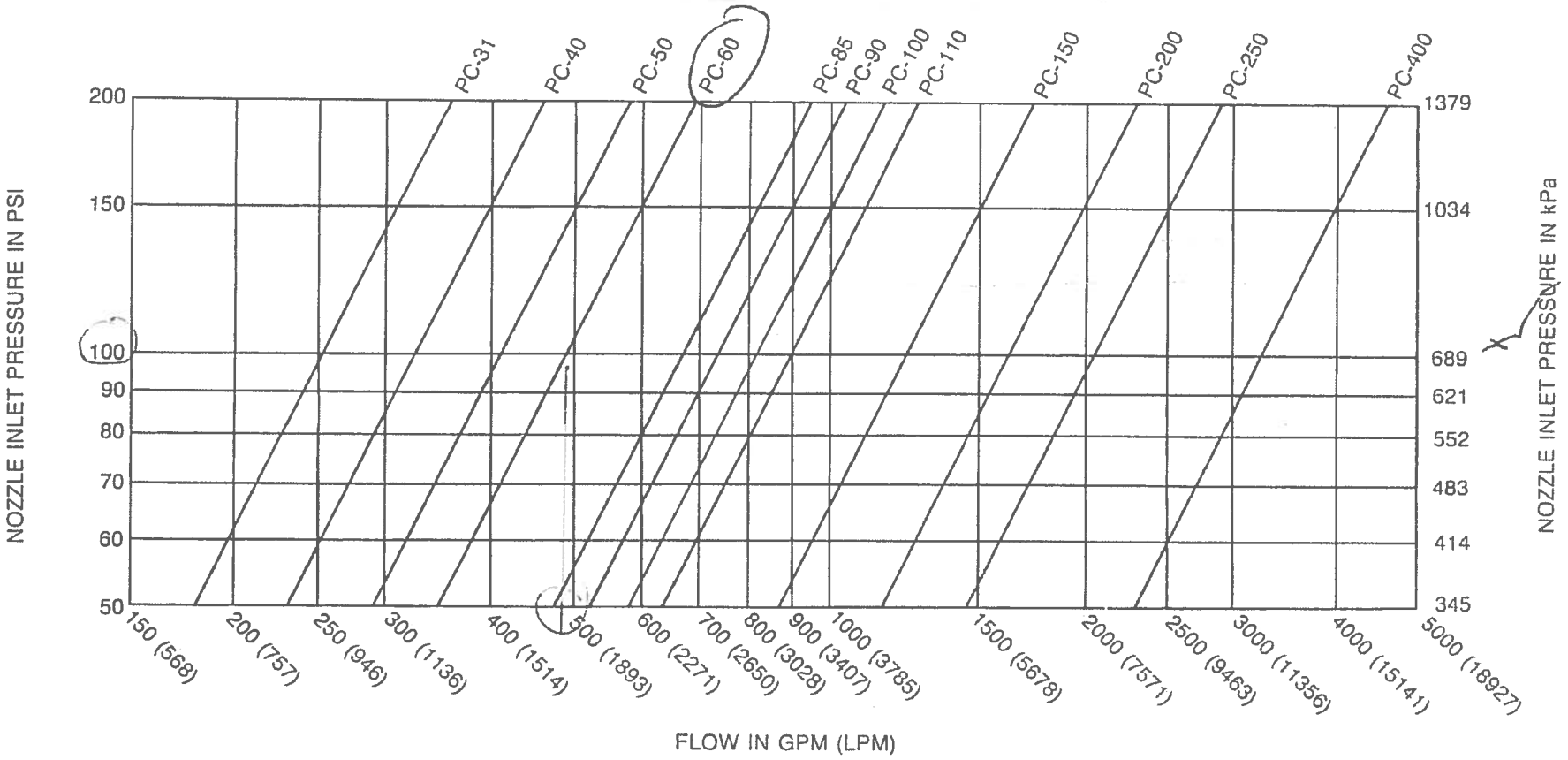
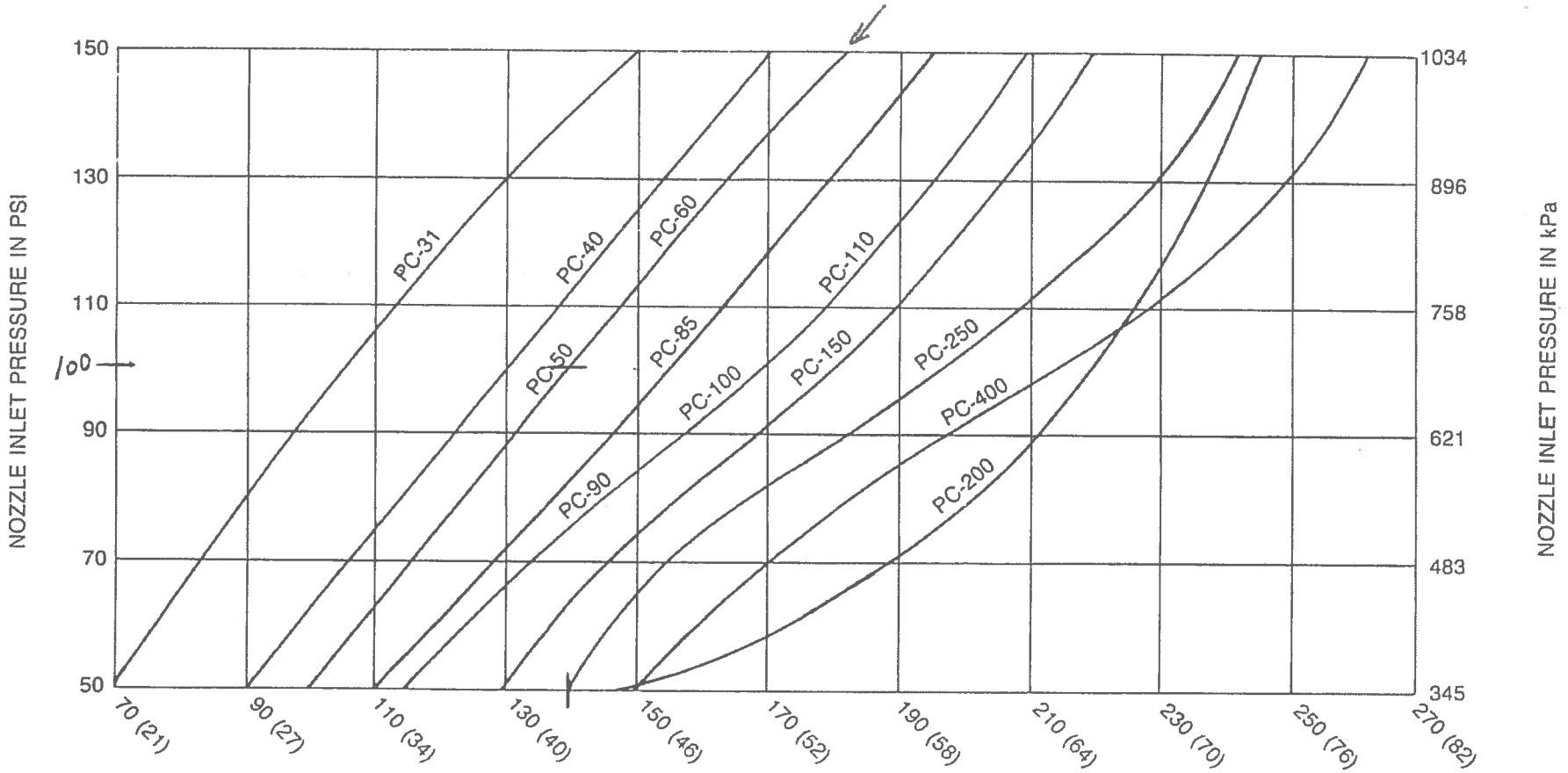
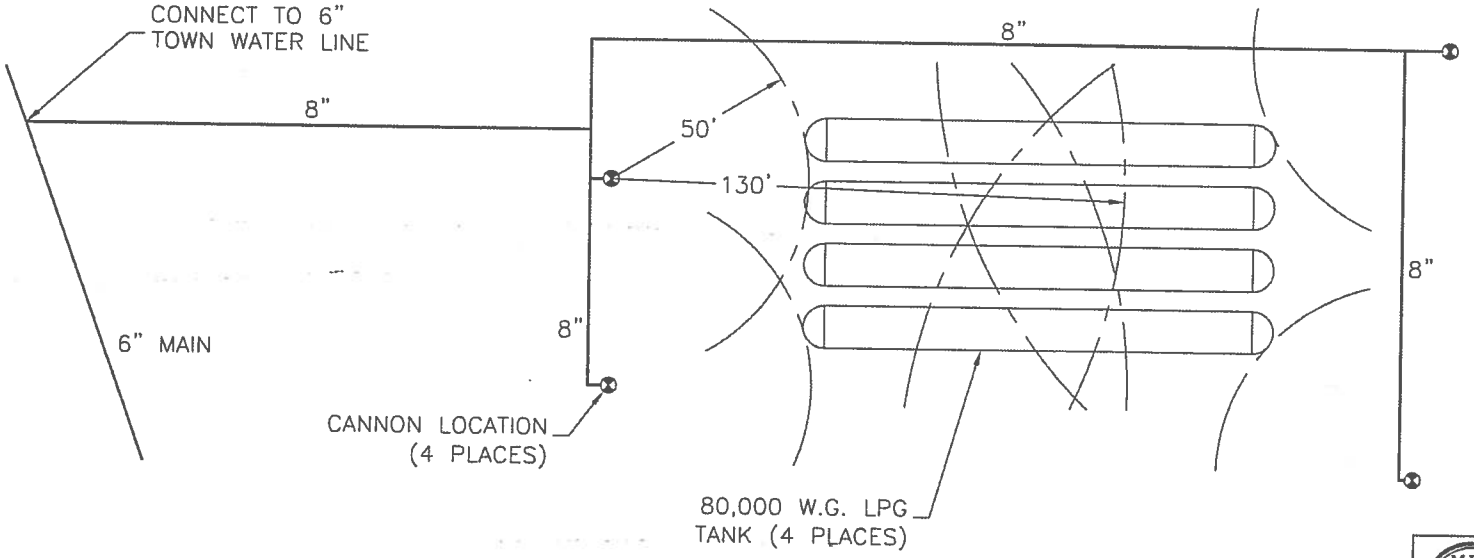


Figure 18. Water or Foam Solution Nozzle Discharge Characteristics



STRAIGHT STREAM RANGE IN FEET (METERS) STILL AIR
Range is with nozzle elevated 22½° and nozzle inlet 3 to 6 feet (1 to 2 meters) above ground level.

Figure 17. Range Characteristics of Straight Stream Nozzles



MPE, INC.
10 PENDLETON DRIVE, HEBRON, CT. 06248
1-800-833-6734 1-860-228-3635
FAX: 1-860-228-8574

REVISION RECORD

DATE	BY	DESCRIPTION
1		
2		
3		
4		
5		

GRAFTON & UPTON RAILROAD
PROPANE RAIL TERMINAL
42 WESTBORO ROAD
GRAFTON, MA

PROPOSED WATER
CANNON LAYOUT

P. E. REVIEW

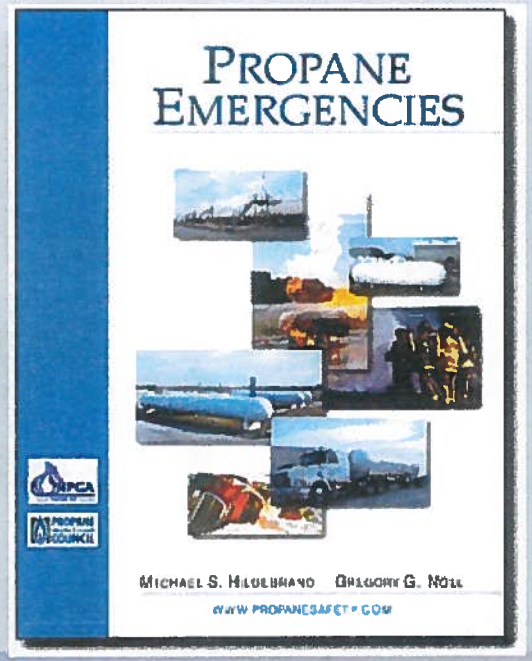
SCALE 1/32" = 1'	JOB NO. GU-01-15	APPROVED	
DESIGNED BY R. CEPPI	DATE 6-19-15	DRAWING NO. GU-01	SHT. NO 1/1
DRAWN BY R.PAAKKONEN	DATE 6-19-15		

Appendix F –
Information on Liquid Propane Gas: Physical Properties and Characteristics and Safety Data Sheet (SDS)

Appendix F - Information on Liquid Propane Gas (LPG)

Physical Properties and Characteristics of Propane

Propane Emergencies



Objectives

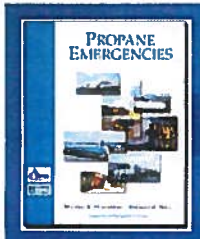
- To Define The Following Physical And Chemical Properties Of Propane And Explain Their Significance In An Emergency:
  - Specific Gravity
  - Vapor Density
  - Boiling Point
  - Expansion Ratio
  - Flammable Limits
  - Ignition Temperature

Processing And Refining LP-Gases

- The Two Major LP-Gases Extracted And Used In Our Industry:
  - Propane
  - Butane
- LP-Gases Are Normally Found Trapped In Pockets With Either Crude Oil Or With Natural Gas.

LP-Gas Blends

- There Are Different Types Or Blends That Are Used In The LP-Gas Industry.
- The Four Major Blends Are:
  - Commercial Propane
  - HD5 Propane
  - Commercial Butane
  - Butane/Propane Blends



Odorization Of Propane

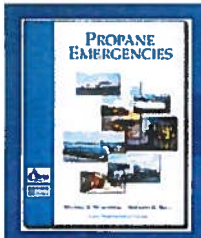
- Propane In Its Natural State Is Odorless And Colorless.
- A Commercial Odorant Is Added So It May Be Detected If Leaked Into The Environment.
- Effective Odorization Serves Two Primary Purposes:
  - Permits The Detection Of Leaks.
  - Reduces Gas Losses Through Early Detection And Repair Of Leaks.

Odorization Of Propane

- Desirable Characteristics For A Gas Odorant Vary Considerably. Some Of These Characteristics Include:
  - Odor
  - Volatility
  - Inertness
  - Absorption By Soil
  - Corrosion
  - Combustion Products

Characteristics Of LP-Gas

- LP-Gases Belong To A Family Of Chemical Compounds Known As Hydrocarbons.
  - Hydrogen And Carbon Atoms Only
- Common Hydrocarbons Are:
  - Methane (CH_4)
  - Ethane (C_2H_6)
  - Propane (C_3H_8)
  - Butane (C_4H_{10})



Characteristics Of LP-Gas

- Tasteless
- Colorless
- Usually Odorless
- When Mixed With The Proper Amount Of Air They Can Burn.
- Most LP-Gases Are Capable Of Being Either A Liquid Or Gas.

Characteristics Of LP-Gas

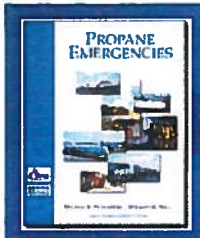
- Most LP-Gases Can Be Stored And Transported As Liquids Under Pressure.
- Under Normal Outdoor Temperatures Liquid LP-Gases Expand Rapidly Into Gas.
- LP-Gases Will Expand When Heat Is Applied.
- LP-Gases Are Not Toxic, But They Present Possible Inhalation Hazards.
- Released In A Confined Space, Propane Can Displace Oxygen.

Specific Gravity And Vapor Density

- Physical Properties Are Very Important In Understanding Propane.
- Vapor Density - How It Compares To Other Vapors And Gases.
- Specific Gravity - How It Compares To Other Liquids.

Specific Gravity Of Liquids

- The Specific Gravity Of A Liquid Is The Comparison Of The Weight Of A Given Volume Of One Liquid At A Certain Temperature With The Weight Of The Same Volume Of Water At The Same Temperature.
- Commercial Propane
  - Liquid At 60° F (Water = 1) = 0.504
  - Gas At 60° F = 1.50 (Air = 1)



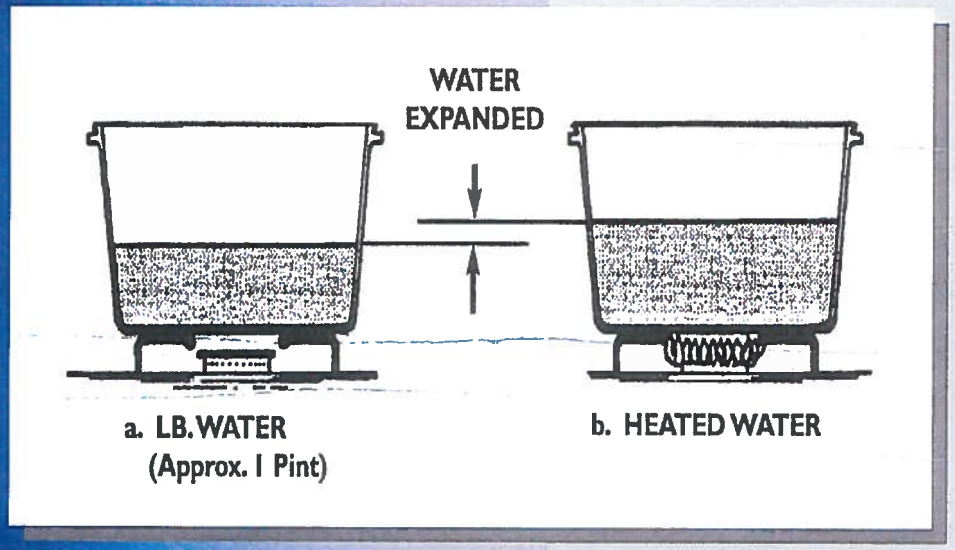
Vapor Density

- Vapor Density Is The Comparison Of The Weight Of A Given Volume Of A Gas At A Certain Temperature With The Same Volume Of Air At The Same Temperature.
- Propane Vapor Has A Vapor Density Of 1.52 At 60° F.
- Propane Vapor Is About 1.5 Times Heavier Than Air (Air = 1.00).

Effects Of Pressure And Temperature On Propane

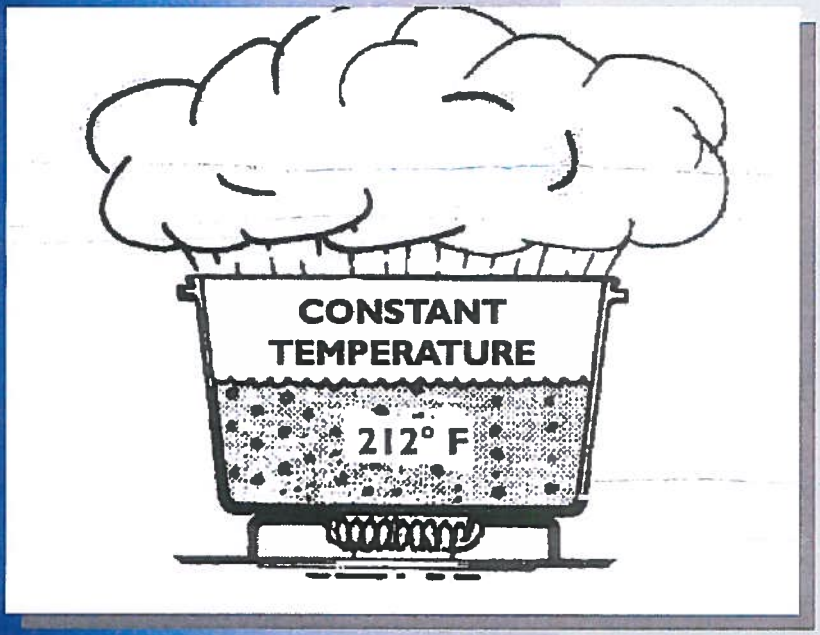
- Three Points Which Must Be Understood:
  - The Effect Of Heat On Liquids
  - Liquids And Boiling Points
  - Storing Liquids Above Their Normal Boiling Points In A Closed Container

The Effect Of Heat On Liquids



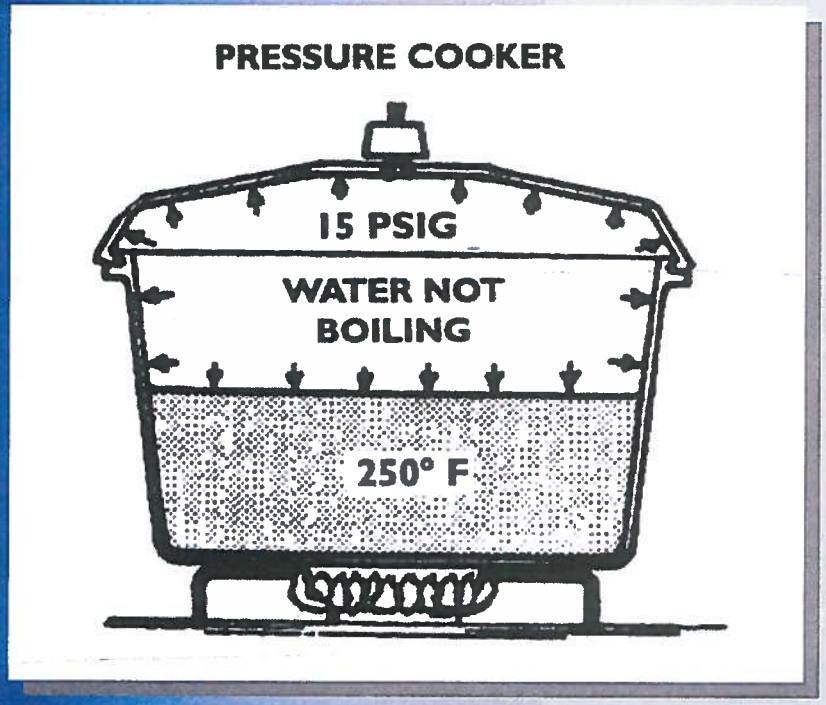
- Adding Heat To Liquid Will Always Cause It To Expand.
- A Common Value To Measure Heat Is A BTU (The Amount Of Heat Needed To Raise The Temperature Of One Pound Of Water 1° F).

Liquids And Boiling Points



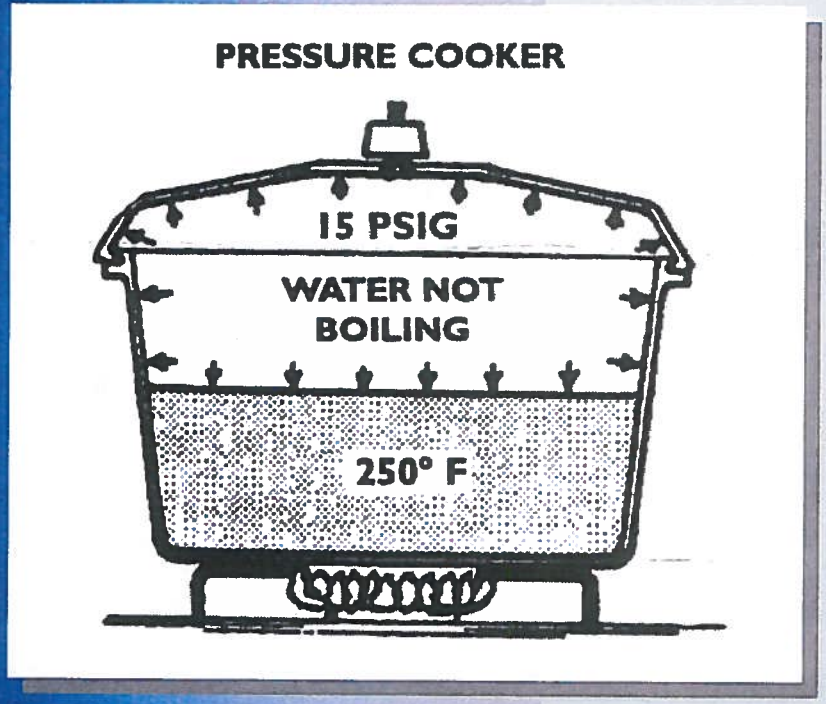
- The Normal Atmospheric Boiling Point Of A Liquid Is The Temperature At Which A Liquid Will Change To A Vapor Under Normal Atmospheric Conditions.

Storing Liquids Above Their Normal Boiling Points



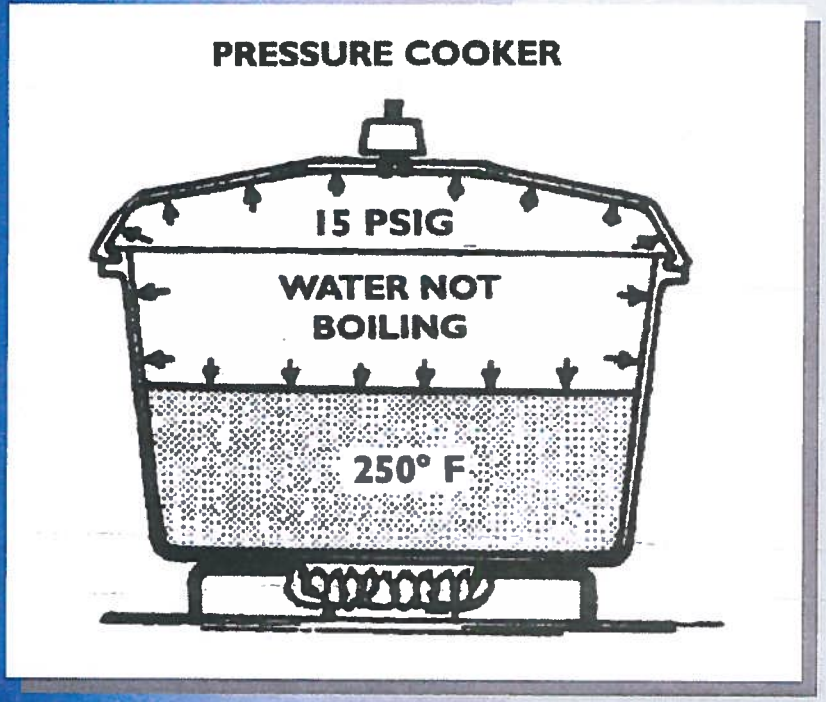
- As Long As The Container Is Open To The Surrounding Atmosphere, The Relationships Between Heat, Temperature, And Boiling Points For The Liquid Will Not Be Changed.

Storing Liquids In A Closed Container



- When The Water Reached 212° F, The Liquid Began To Boil Off Into Steam.
- Since The Container Is Closed, The Space Above The Liquid Is Pressurizing. Once The Container Is Pressurized To The Proper Point, The Boiling Action Will Stop.
- The Increased Steam Pressure Prevents Any Additional Water From Changing Into Steam. At This Point Temperature And Pressure Are In Balance.

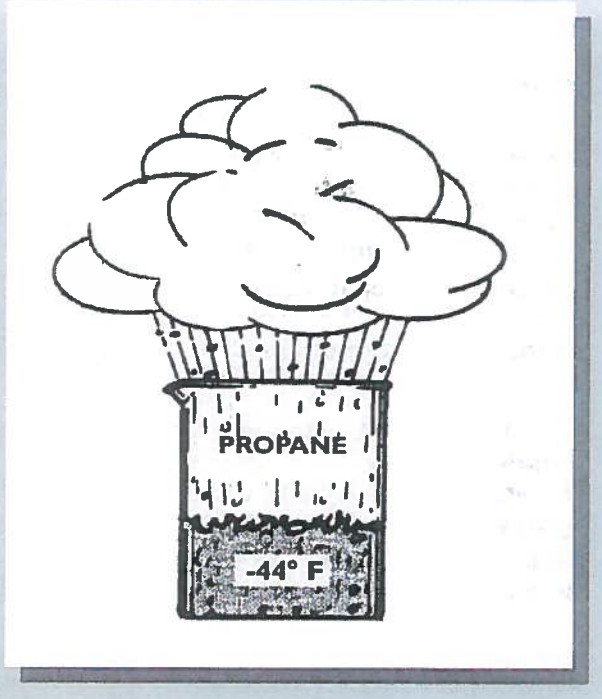
Storing Liquids In A Closed Container



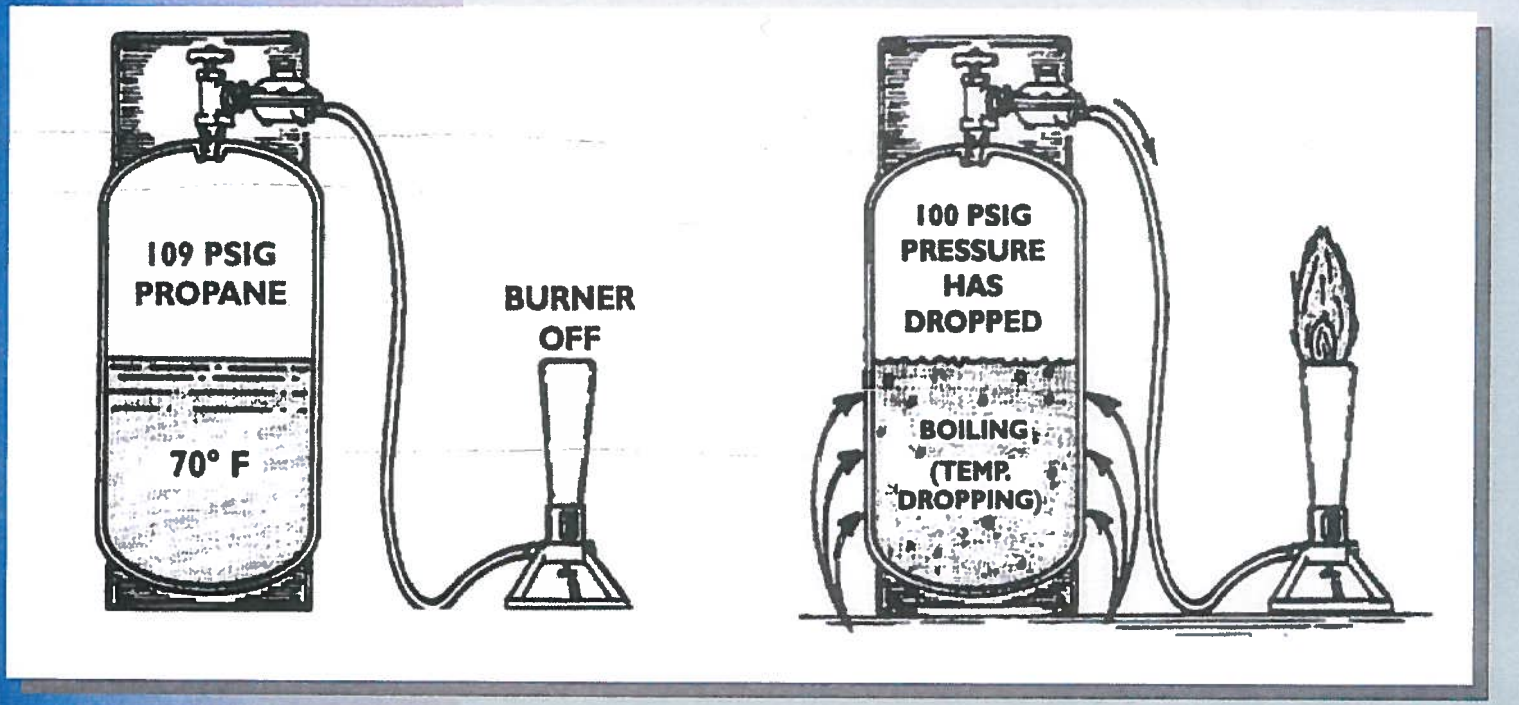
- If A Relief Valve In The Pressure Cooker Opens And Discharges Steam, The Liquid Will Immediately Boil Off Trying To Re-establish The Balance Between Temperature And Pressure.
- When The Relief Valve Closes, The Pressure Will Again Increase.
- As Soon As The Pressure, Liquid Temperature, And Added Heat Are In Balance, The Water Will Again Stop Boiling.

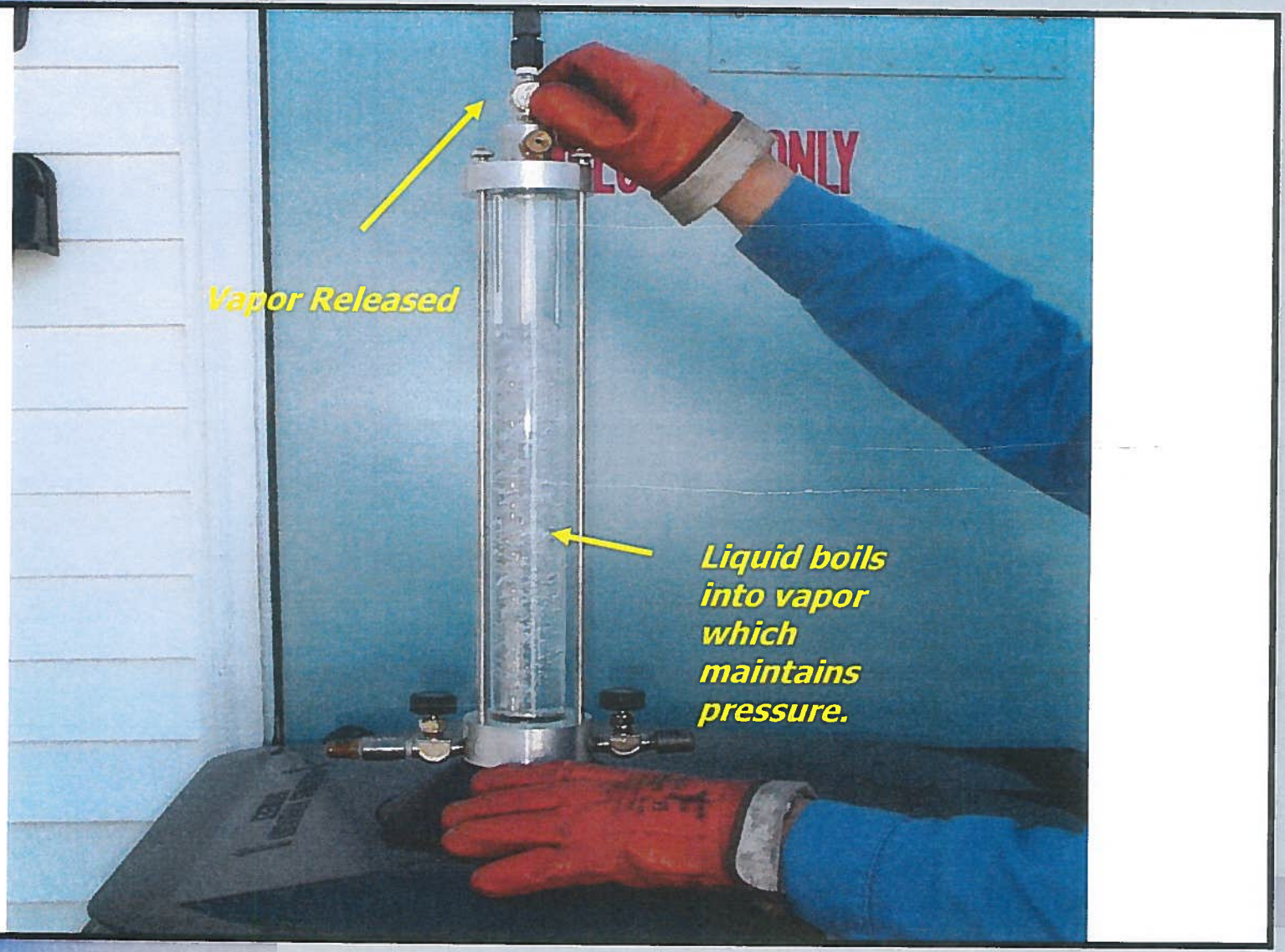
Storing Propane In A Closed Container

- Propane Is Affected By Heat And Pressure In Much The Same Way As Water.
- The Problem With Storing Propane In An Open Container Is It Has A Boiling Point Well Below The Boiling Point Of Water.
- The Normal Boiling Point Of Propane Is -44° F.
- When Placed In Pressure-tight Containers, Propane Can Be Stored As A Liquid Under Pressure.
- Drops In Pressure Causes Propane To Boil Off.



Storing Propane In A Closed Container




Vapor Released
Liquid boils into vapor which maintains pressure.

Four Important Characteristics When Storing Propane In A Closed Container

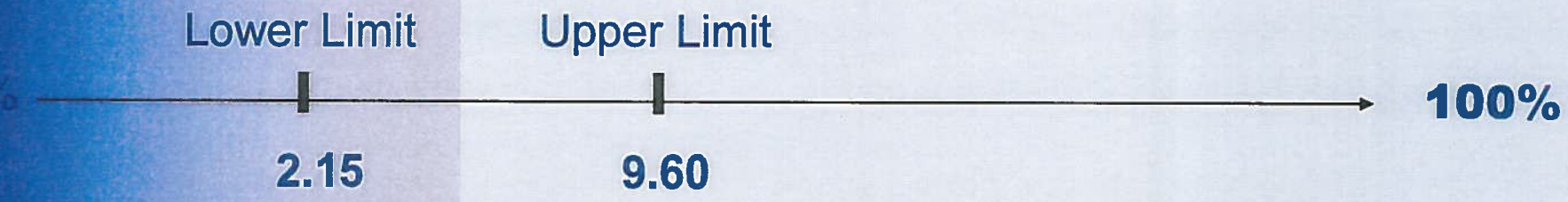
1. Heat Added To Propane In A Tank Or Cylinder Is Transferred Directly From The Air Surrounding The Container. These Changes In Liquid Temperature Also Cause Changes In Vapor Pressure.
2. Propane, Like Water, Will Expand When Heat Is Added.
3. Due To Changes In Liquid Volume And High Storage Pressures, Every Propane Container Is Equipped With At Least One Pressure Relief Valve.
4. Liquid Leaks Are Generally More Dangerous Than Gas Leaks. One Cubic Foot Of Propane Liquid Will Boil Off Into Approximately 270 Cubic Feet Of Vapor.

Flammable Limits

- A Flammable Limit Is Simply The Percentage Of Gas Needed In A Gas/Air Mixture To Support Combustion.
- Normally, This Value Is Given In Both Upper And Lower Limits Of Flammability.
- Flammable Limits And Explosive Limits Have The Same Meaning.

Flammable Limits

- The Upper Limit Is The Percentage Of Gas In The Richest (Most Gas) Mixture That Will Support Combustion.
- The Lower Limit Is The Percentage Of Gas In The Leanest (Least Gas) Mixture That Will Support Combustion.

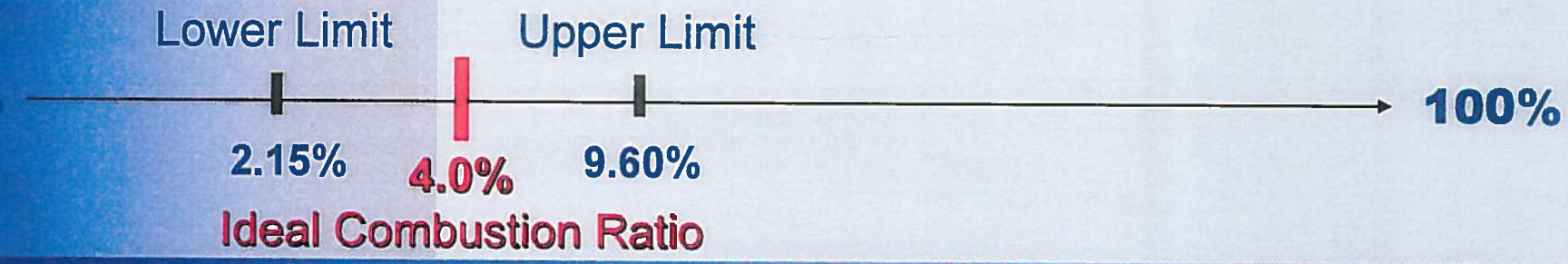


Combustion Ratio

- Although Propane Vapor Will Burn In Any Mixture Within Its Flammability Limits, Combustion May Not Produce A "Clean Burn."
- Insufficient Combustion Produces:
  - Insufficient Heat
  - Unburned Gas
  - Harmful Combustion By-products

Combustion Ratio

- Most Gas Appliance Burners Are Designed And Adjusted To Burn A Gas Air Mixture. This Mixture Is Commonly Referred To As The Ideal Combustion Ratio.
  - The Ideal Combustion Ratio For Propane Is 24 Parts Of Air (96%) To 1 Part Of Propane (4%).



Ignition Temperature

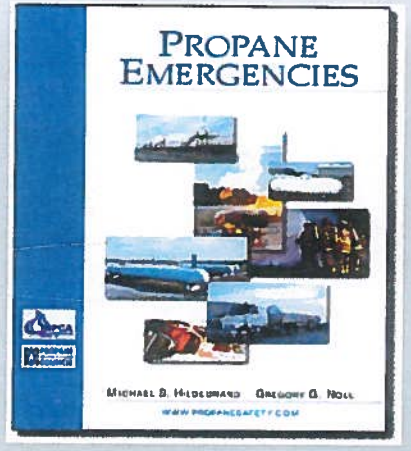
- Minimum Temperature Needed For A Mixture Of Propane And Air To Ignite.
  - The Ignition Temperature Of Propane Is Between 920° F For Propane Is Another Flame, Such As The Flame Of A Pilot Burner, Match Or Cigarette Lighter.

Heat Value

- The Purpose Of Burning Propane As Efficiently As Possible Is To Develop As Much Heat As Possible Per Cubic Foot Of Propane.
- The Heat Produced By Burning Propane Is Expressed In Btu's Per Cubic Foot Of Gas Or In Btu's Per Gallon.
- According To NFPA #58, The Heating Value For Propane (Vapor) Is 2,488 BTU Per Cubic Foot.

Summary

Propane Emergencies



MPE, Inc.
Design & Construction Services

10 Pendleton Drive
P.O. Box 259
Hebron, CT 06248
(860) 228-3636 • (800) 833-6734
FAX (860) 228-8574

Mr. Thomas Godfrey
The Godfrey Group
110 New Hampshire Drive
Webster, NH 03303

October 12, 2012

Re: Hydrant Flow Test – Rail Yard – Grafton, MA

A hydrant flow test was conducted using town hydrants on Westborough Street in the area of the rail yard.

The gauge hydrant was a new hydrant recently installed with the new 8" main that ended just after the hydrant. From this point the existing 6" water main runs up past the flow hydrant to a point at the corner of North Main Street. This section of 6" is scheduled to be replaced next year which will improve flow.

This area has a good town grid of 8" and 12" mains that feed the 6" main in front of the rail yard from both directions.

The flow hydrant is an older hydrant and the shut-off valve was buried under the asphalt in the street. The water department guy restricted the flow from this hydrant because he was afraid if something happened to the hydrant he would not be able to shut it off. When conducting a normal hydrant flow test you would flow at least one full open 2½" hydrant butt and depending on the flows, possibly two (2) 2½" hydrant butts and lastly maybe the hydrant pumper connection. He required me to use a play pipe with a 1¾" outlet on one of the 2½" outlets, which limited the flow. I would have liked to see higher flows to see the effect it would have on the 6" underground that runs in front of the rail yard.

Any new underground run into the rail facility for the use of feeding water cannons should be connected to the 8" water main on Westborough Street.

Robert Ceppi
Fire Protection Engineer #33625
Sprinkler Contractor Lic. #801

MPE, Inc.
Design and Construction Services
10 Pendleton Drive
P.O. Box 259
Hebron CT 06248
(860) 228-3636 • (800) 833-6734
FAX (860) 228-8574

FLOW TEST

TEST No.: 1 CLIENT: SPICER GAS

LOCATION:
STREET 42 Westboro ST
CITY/STATE Grafton MA
VICINITY OF Railroad Yard

DATE: 10/5/12 TIME: 930 DAY OF WEEK: Friday

PRESSURE READINGS: ELEV.: 0
HYDRANT No.: 1 ~~RISER~~ No.:
STATIC PRESSURE (BEFORE FLOW TEST): 130 psi
RESIDUAL PRESSURE (FLOWING): 124 gpm
STATIC PRESSURE (AFTER FLOW TEST): 130 psi

FLOW READINGS: ELEV.: 0
HYDRANT No.: 2 ~~RISER~~ No.:
* SIZE OF OUTLET: 1¾ COEF. 1
PITOT TUBE PRESSURE (psi) EQUIVALENT FLOW (gpm)
70 761

TOTAL DISCHARGE: 761

AVAILABLE FLOW at 20 psi: 3660 gpm

TEST CONDUCTED BY: ROBERT CEPPI

TEST WITNESSED BY: STEVE from Water Dept

SKETCH AND/OR COMMENTS

* USED A PLAYPIPE ON A 2½" OUTLET PER THE WATER DEPT.
SEE ATTACHED SKETCH

MPE, Inc.
Design and Construction Services
10 Pendleton Drive
P.O. Box 259
Hebron CT 06248
(860) 228-3636 · (800) 833-6734
FAX (860) 228-8574

FLOW TEST

TEST No.: 2 CLIENT: SPICER GAS

LOCATION:
STREET: 42 Westboro ST
CITY/STATE: Grafton MA
VICINITY OF: Railroad Yard

DATE: 10/5/12 TIME: 1000 DAY OF WEEK: Friday

PRESSURE READINGS: ELEV.: 0
HYDRANT No.: 1 ~~RISER~~ No.:
STATIC PRESSURE (BEFORE FLOW TEST): 130 psi
RESIDUAL PRESSURE (FLOWING): 120 gpm
STATIC PRESSURE (AFTER FLOW TEST): 130 psi

FLOW READINGS: ELEV.: 0
HYDRANT No.: 2 ~~RISER~~ No.:
* SIZE OF OUTLET: 1 3/4 COEF.: 1
PITOT TUBE PRESSURE (psi): 78 EQUIVALENT FLOW (gpm): 803

TOTAL DISCHARGE: 803

AVAILABLE FLOW at 20 psi: gpm

TEST CONDUCTED BY: ROBERT CEPPI

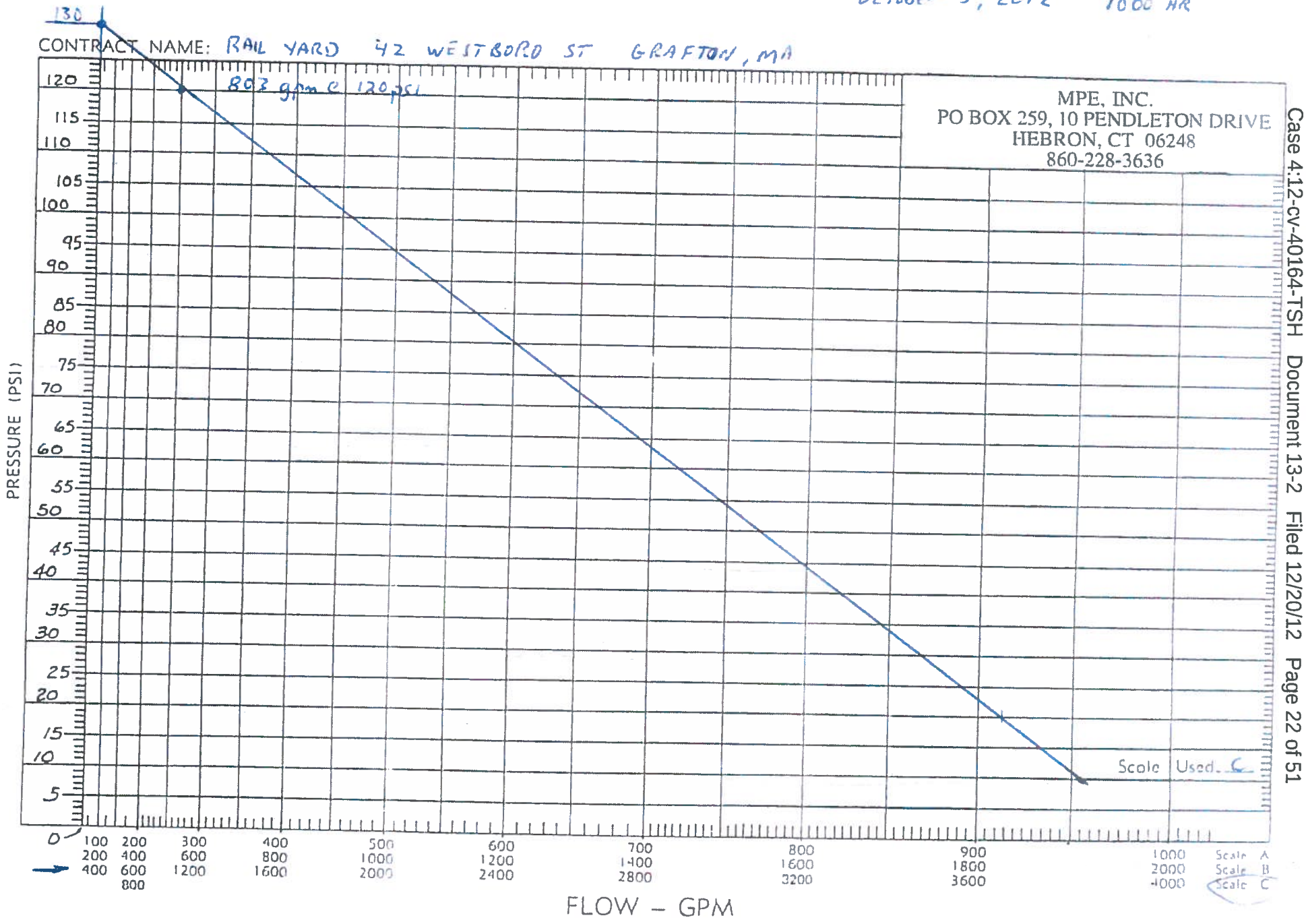
TEST WITNESSED BY: STEVE from Water Dept

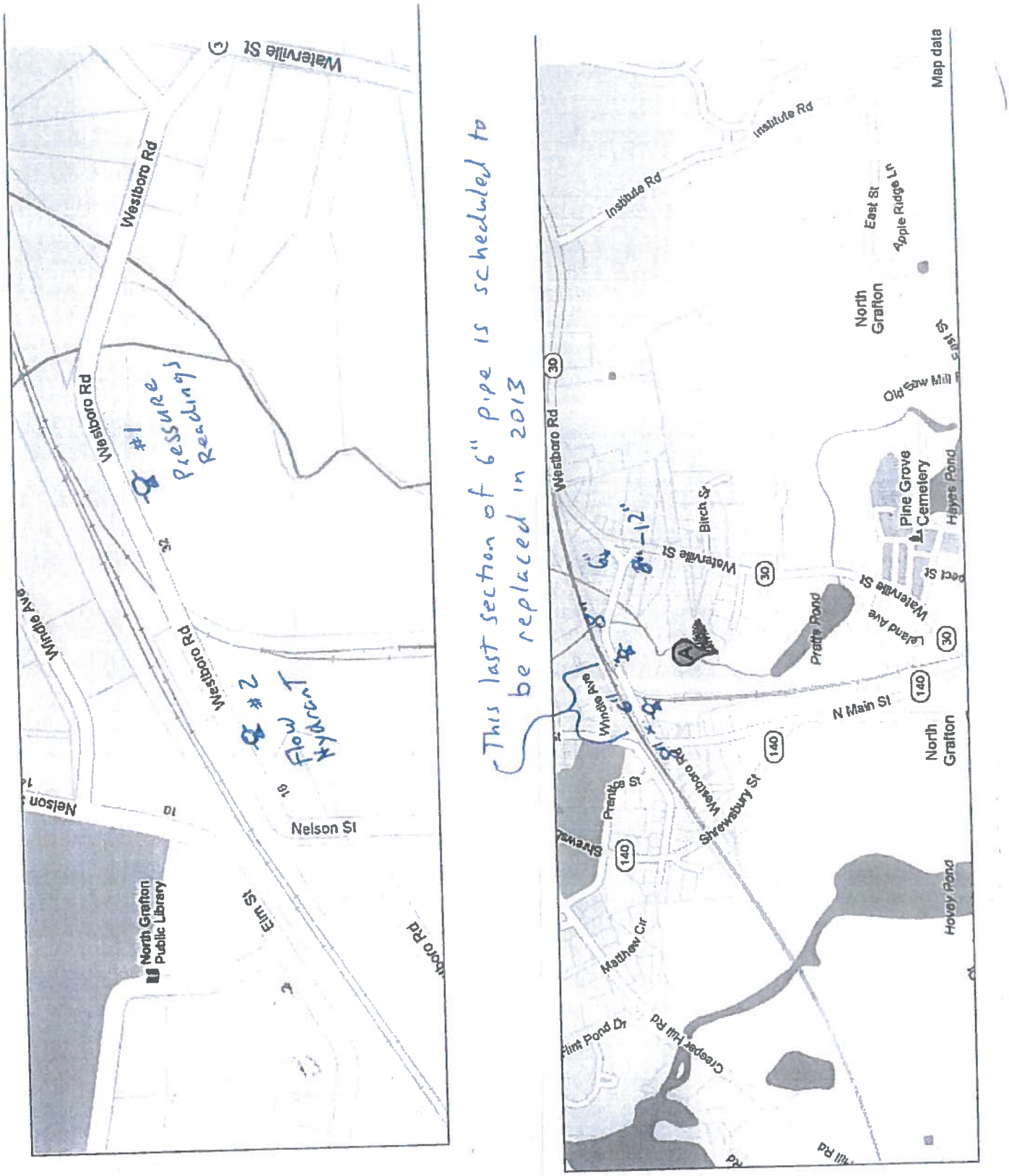
SKETCH AND/OR COMMENTS

* USED A PLAYPIPE ON A 2½" OUTLET PER THE WATER DEPT.
SEE ATTACHED SKETCH

October 5, 2012 1000 HR

CONTRACT NAME: RAIL YARD 42 WESTBORO ST GRAFTON, MA




Waterville St
Westboro Rd
#1 Pressure Reading
#2 Flow Hydrant
Nelson St
Elm St
North Grafton Public Library
This last section of 6" pipe is scheduled to be replaced in 2013
Institute Rd
East St
Apple Ridge Ln
North Grafton
Old Saw Mill
Pine Grove Cemetery
Hayes Pond
Birch St
Leland Ave
Pratts Pond
N Main St
Prentice St
Shrewsbury St
Matthew Cir
Creeper Hill Rd
Hovey Pond
Map data

APPENDIX (D) - NFPA/NPGA FIRE SAFETY ANALYSIS CALCULATIONS AND WORKSHEETS

Form 4.1
Initial Data on the LP-Gas Facility

A	B	C
Item #	Information Item	Data
1	Name of the LP-Gas Facility Owner or Operator	Grafton-Upton Railroad Propane Bulk Plant
2	Contact Name:	Eric Moffett
3	Contact Telephone & Fax Numbers	(860) 627-8924
4	Contact Email Address	ericmoffett@graftonuptonrr.com
5	Mailing Address	Street 1: 42 Westboro road
		Street 2:
		City, State, Zip: Grafton, MA

Form 4.2
Facility Storage Capacity [1,2,3,5]

A	B	C	D
Item #	Individual Container Water Capacity (w.c.) (gallons)	Number of containers	Total Water Capacity (w.c.) of each container size (gallons)
1	500	0	0
	1,000	0	0
	2,000	0	0
	4,000	0	0
	10,000	0	0
	18,000	0	0
	30,000	0	0
	60,000	0	0
	Other: 80000	4	320000
	Other:	0	0
	Other:	0	0
	Other:	0	0
2	**Aggregate Water Capacity[4]**		320000

Notes:
(1) Column D = Column B x Column C.
(2) Parked bobtails, transports and tank cars should not be considered for aggregate capacity calculations.
(3) Do not consider containers that are not connected for use.
(4) For the purpose of this manual, "Aggregate Water Capacity" means any group of single ASME storage containers separated from each other by distances less than those stated in the aboveground containers column of Table 6.3.1.
(5) This form contains formulas that will automatically calculate results based on the values entered in the related cells. To activate the calculations, click in another number field, such as one in Column C.

If the aggregate water capacity of the LP-Gas facility is less than or equal to 4,000 gallon (w.c.), no further assessment is required.

YOU CAN STOP HERE.

Form 4.3
Additional Information on the LP-Gas Facility

☐ Existing Facility; Built to NFPA 58 Edition _____ ☒ Proposed Facility

a) Name of the Facility (if applicable): Grafton & Upton Railroad Propane Bulk Plant

b) Type of LP-Gas Facility: ☐ Commercial ☐ Industrial ☒ Bulk Plant

c) Facility is located in: ☒ City Industrial Zone ☒ Suburban Area ☐ Rural Area
☐ City Commercial Zone

d) Facility neighbors§: ☐ Agri Fields ☒ Commercial Bldgs. ☐ Flammable Liquids Storage
(Check all that apply) ☒ Industrial Activity (metal fabrication, cutting and welding, etc.)
☐ Manufacturing ☒ Others (explain) Railroad

e) Geographic Location of Facility/Address: 42 Westboro Road
North Grafton, MA

f) Landmarks, if any: _____
_____

g) LP-Gas liquid supply by: ☐ Bobtail ☐ Truck Transport ☒ Rail Tank Car
(Check all that apply) ☐ Pipeline

h) LP-Gas Distribution by: ☐ Liquid Piping ☒ Truck Transport ☐ Vapor Piping
Plant (Check all that apply): ☐ Bobtail ☐ Dispensing or Vehicle Liquid Fueling

i) Number of Vehicle Entrances: ☒ One ☐ Two ☐ More than two

j) Type of Access Roads to the Facility: ☐ Rural ☒ City or Town ☐ Highway
(One check per line) Entrance 1: ☐ Dirt road ☐ Gravel road ☒ Paved
(One check per line) Entrance 2: ☐ Dirt road ☐ Gravel road ☐ Paved

k) Staff presence: ☐ Not staffed ☐ Only during transfer operations
☐ Staffed always (24/7) ☒ Only during business hours
☐ Other (Explain) _____

l) Location and distances to Assembly, Educational or Institutional Occupancies surrounding the facility, if any, within 250 ft from the facility boundary in the direction of the assets.
None within 250 ft. Nearest Assembly, Education or Institutiaonl Occupancy is Grafton Library, 257 yards (.28miles) at 300 degrees true (WNW) from the terminal.

n) Overview plot plan of the facility attached? ☒ Yes ☐ No

§ All properties either abutting the LP-Gas facility or within 250 feet of the container or transfer point nearest to facility boundary.

Form 5.4
Compliance with Code Requirements for Appurtenances on Containers Having a Water Capacity Greater Than 4,000 Gallons Used in Bulk Plants and Industrial Plants

A	B	C	D		E	F	G
Container #	LP-Gas inlet to and outlet from the container**		Enter Configuration Number		Total Number of Product Control Appurtenances: Required by NFPA 58 (applicable edition)	Total Number of Product Control Appurtenances: Installed on the container	NFPA 58 Section Reference (2011 edition)
1	Vapor	Inlet	5-2	1	1	See §5.7.4.2 and Table 5.7.4.2	
		Outlet	5-3	1	1		
	Liquid	Inlet	5-6	1	1		
		Outlet	5-7	2	2		
2	Vapor	Inlet	5-2	1	1		
		Outlet	5-3	1	1		
	Liquid	Inlet	5-6	1	1		
		Outlet	5-7	2	2		
3	Vapor	Inlet	5-2	1	1		
		Outlet	5-3	1	1		
	Liquid	Inlet	5-6	1	1		
		Outlet	5-7	2	2		
4	Vapor	Inlet	5-2	1	1		
		Outlet	5-3	1	1		
	Liquid	Inlet	5-6	1	1		
		Outlet	5-7	2	2		

** If the container does not provide an opening for the specific function listed, enter 0 (zero) in columns E and F corresponding to that row.

If in Form 5.4 any one of the numbers in column F is less than the number in Column E of the corresponding row, these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 5.5
Requirements for Transfer Lines of 1½-inch Diameter or Larger, Liquid-into-Containers

A	B	C	D	E	F
Item #	Appurtenance (Either No. 1 or No. 2)**	Appurtenance Provided with the Feature	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2011 edition)
1	Emergency shutoff valve (ESV) (Ref § 6.12)	Installed within 20 ft. of lineal pipe from the nearest end of the hose or swivel-type connections.	☒	☐	6.12.2
		Automatic shutoff through thermal (fire) actuation element with maximum melting point of 250 °F	☒	☐	6.12.6
		Temperature sensitive element (fusible link) installed within 5 ft from the nearest end of the hose or swivel type piping connected to liquid transfer line.	☒	☐	6.12.6
		Manually operated remote shutoff feature provided for ESV.	☒	☐	6.12.10 (1)
		Manual shutoff device provided at a remote location, not less than 25 ft., and not more than 100 ft. from the ESV in the path of egress.	☒	☐	6.12.10 (2)
		An ESV is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of size 1½ inch in diameter or larger on the other side.	☒	☐	6.12.5 6.18.2.6 (1)
		Breakaway protection is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	☒	☐	6.12.8
2	Backflow check valve (BCK)**	Installed downstream of the hose or swivel-type connection	☒	☐	6.12.3
		BCK is designed for this specific application.	☒	☐	6.12.4
		A BCK is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1½ inch in diameter or larger on the other side.	☒	☐	6.12.5
		Breakaway protection is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	☒	☐	6.12.8

** In lieu of an emergency shutoff valve, the backflow check valve (BCK) is only permitted when flow is only into the container and shall have a metal-to-metal seat or a primary resilient seat with metal backup, not hinged with a combustible material (6.12.3, 6.12.4).

Form 5.6
Requirements for Transfer Lines of 1½-inch Diameter or Larger, Liquid Withdrawal From Containers

A	B	C	D	E	F
Item #	Appurtenance	Appurtenance Provided with the Feature	Installed in the facility?		NFPA 58 Section Reference (2011 Edition)
			Yes	No	
1	Emergency shutoff valve (ESV) (Ref § 6.12)	Installed within 20 ft. of lineal pipe from the nearest end of the hose or swivel-type connections.	☒	☐	6.12.2
		Automatic shutoff through thermal (fire) actuation element with maximum melting point of 250 °F.	☒	☐	6.12.6
		Temperature sensitive element installed within 5 ft from the nearest end of the hose or swivel type piping connected to liquid transfer line.	☒	☐	6.12.6
		Manually operated remote shutoff feature provided for ESV.	☒	☐	6.12.10 (1)
		Manual shutoff device provided at a remote location, not less than 25 ft., and not more than 100 ft. from the ESV in the path of egress.	☒	☐	6.12.10 (2)
		An ESV is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1½ inch in diameter or larger on the other side.	☒	☐	6.12.5 6.18.2.6 (1)
		Breakaway protection is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	☒	☐	6.12.8
		Number of ESV's in liquid withdrawal service	8		

Note: If more than one ESV is installed in the facility, use one Form 5.6 for each ESV.

Form 5.7
Requirements for Vapor Transfer Lines 1¼-inch Diameter or Larger

A	B	C	D	E	F
Item #	Appurtenance	Appurtenance Provided with the Feature	Installed in the facility?		NFPA 58 Section Reference (2011 edition)
			Yes	No	
1	Emergency shutoff valve (ESV) (Ref § 6.12)	Installed within 20 ft. of lineal pipe from the nearest end of the hose or swivel-type connections.	☒	☐	6.12.2
		Automatic shutoff through thermal (fire) actuation element with maximum melting point of 250 °F	☒	☐	6.12.6
		Temperature sensitive element installed within 5 ft from the nearest end of the hose or swivel type piping connected to liquid transfer line.	☒	☐	6.12.6
		Manually operated remote shutoff feature provided for ESV.	☒	☐	6.12.10 (1)
		Manual shutoff device provided at a remote location, not less than 25 ft., and not more than 100 ft. from the ESV in the path of egress.	☒	☐	6.12.10 (2)
		An ESV is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1-1/4 inch in diameter or larger on the other side.	☒	☐	6.12.5 6.18.2.6 (1)
		Breakaway protection is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	☒	☐	6.12.8
2	Backflow check valve (BCK)**	Installed downstream of the hose or swivel-type connection	☒	☐	6.12.3
		BCK is designed for this specific application.	☒	☐	6.12.4
		A BCK is installed on each leg of a multi leg piping each of which is connected to a hose or a swivel type connection on one side and to a header of 1-1/4 inch in diameter or larger on the other side.	☒	☐	6.12.5
		Breakaway protection is provided such that in any pull-away break will occur on the hose or swivel-type connection side while retaining intact the valves and piping on the plant side.	☒	☐	6.12.8

** In lieu of an emergency shutoff valve, the backflow check valve (BCK) is only permitted when flow is only into the container and it shall have a metal-to-metal seat or a primary resilient seat with metal backup, not hinged with a combustible material (6.12.3, 6.12.4).

If a checkmark is made in the "No" column of any one of Form 5.5, Form 5.6 or Form 5.7, then these items must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

If the LP-Gas facility is designed using ALTERNATE PROVISIONS for the installation of ASME CONTAINERS, then continue the analysis below. Otherwise skip Forms 5.8 and 5.9 and go to Chapter 6.

Form 5.8
Evaluation of Redundant Fail-Safe Design

A	B		C	D	E	F
Item #	Description		Features	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2011 edition)
1	Container sizes for which the appurtenances are provided		Appurtenances and redundant fail-safe equipment are provided for each container of water capacity 2,001 gal. through 30,000 gal.	☐	☐ Not Applicable	6.26.3 and 6.26.4
2	Liquid or vapor withdrawal (1-1/4 in. or larger)		Internal valve having internal excess-flow valve	☒	☐	6.26.3.1 and 6.26.3.2
			Positive shutoff valve installed as close as practical to the internal valve	☒	☐	6.26.3.4
3	Liquid or vapor inlet		Internal valve having internal excess-flow valve or backflow check valve	☒	☐	6.26.3.5
			Positive shutoff valve installed as close as possible to the internal valve or the backflow check valve	☒	☐	6.26.3.5
4	Railcar transfer	Flow into or out of railroad tank car	Approved emergency shutoff valves installed in the transfer hose or the swivel-type piping at the tank car end	☒	☐	6.18.2.6 (1) and 6.26.4.1
		Flow only into railroad tank car	Approved emergency shutoff valve or back-flow check valve installed in the transfer hose or the swivel-type piping at the tank car end	☒	☐	6.18.2.6 (2) and 6.26.4.1
5	Cargo tank transfer		Protection provided in accordance with 6.26.4.1	☒	☐	6.26.4.1
6	Automatic closure of all primary valves (IV & ESV) in an emergency		By thermal (Fire) actuation	☒	☐	6.26.4.2
			Actuated by a hose pull-away due to vehicle motion	☒	☐	6.26.4.2
7	Manually operated remote shutdown of IV and ESV		Remote shutdown station within 15 ft of the point of transfer	☒	☐	6.26.4.3 (A)
			Another remote shutdown station between 25 ft and 100 ft of the transfer point	☒	☐	6.26.4.3 (B)
			Shutdown stations will shut down electrical power supply, if any, to the transfer equipment and primary valves	☒	☐	6.26.4.3
			Signs complying with the requirements of 6.26.4.3 (C) provided	☒	☐	6.26.4.3 (C)

Note: If the facility does not have a rail terminal, write the word NA in both the "Yes" column and the "No" column in item 4 of this Form in the railroad tank car row. Similar option is also available if there is no cargo tank vehicle transfer station.

If the LP-Gas facility is provided with LOW EMISSION TRANSFER EQUIPMENT, then complete Form 5.9 below. Otherwise skip section 5.3.2 and go to Chapter 6.

Form 5.9
Evaluation of Low Emission Transfer Equipment

A	B	C		D	E	F
Item #	Description	Features		Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2011 Edition)
1	Transfer into permanently mounted ASME containers on vehicles	Delivery nozzle and filler valve- Max. liquid release after transfer of 4 cc.	Fixed maximum liquid level gage not used during transfer operations	Not Applicable		6.26.5.1 (B)
2	Transfer into stationary ASME containers. delivery valve and nozzle combination	During product transfer or post transfer uncoupling of the hose, liquid product volume released to the atmosphere	Does not exceed 4 cc (0.24 in^3) from a hose of nominal size 1 in or smaller	Not Applicable		6.26.5.2 (A)
			Does not exceed 15 cc (0.91 in^3) from a hose of nominal size larger than 1 in.	Not Applicable		6.26.5.2 (B)
3	Transfer into stationary ASME containers maximum filling limit	Do containers of less than 2,001 gal (w.c.) have an overfilling prevention device or another approved device?		Not Applicable		6.26.5.2 (F)
		Do containers 2,001 gal (w.c.)or greater have a float gage or other non-venting device?		☒	☐	6.26.5.2 (E)
4	Transfer into stationary ASME containers fixed maximum liquid level gage	Not used during routine transfer operations but used to calibrate other non-venting liquid level gages in the container		☒	☐	6.26.5.2 (C,D)

Note: 1) If the facility does not have a particular feature described in items 2 or 3, write "NA" in both the "Yes" and "No" columns corresponding to its row.

If separation distance reductions are intended, checkmarks made in the "No" column of either Form 5.8 or Form 5.9 must be addressed and brought into compliance with the specific edition of NFPA 58 that the facility was constructed to.

Form 6.1
Evaluation of Physical Protection and Other Measures

A	B	C	D	E	F
#	Item	Features	Installed in the facility? Yes	Installed in the facility? No	NFPA 58 Section Reference (2011 Edition)
1	Lighting‡	Provide lighting for nighttime operations to illuminate storage containers, container being loaded, control valves, and other equipment	☒	☐	6.18.5
2	Vehicle impact protection	Protection against vehicular (traffic) impacts on containers, transfer piping and other appurtenances is designed and provided commensurate with the size of vehicles and type of traffic in the facility. (Example protection systems include but not limited to (1) Guard rails, (2) Steel bollards or crash posts, (3) Raised sidewalks.	☒	☐	6.6.1.2, 6.9.3.10 and 6.19.3.2
3	Protection against corrosion	Provide protection against corrosion where piping is in contact with supports or corrosion causing substances.	☒	☐	6.9.3.11
Complete only 4A or 4B					
4A	Perimeter Fence	Is an industrial type or chain link fence of at least 6 ft high or equivalent protection provided to enclose (all around) container appurtenances, pumping equipment, loading and unloading and container filling facilities?	☒	☐	6.18.4.2
		Are at least two means of emergency accesses (gates) from the enclosure provided? **NOTE: Write "N.A." (not applicable) if** (i) The area enclosed is less than 100 ft^2, or (ii) The point of transfer is within 3 ft of the gate, or containers are not filled within the enclosure	☒	☐	6.18.4.2 (A)
		Is a clearance of at least 3 feet all around to allow emergency access to the required means of egress provided?	☒	☐	6.18.4.2 (B)
	Guard Service	If a guard service is provided, does this service cover the LP-Gas plant and are the guard personnel provided with appropriate LP-Gas related training, per section 4.4 of NFPA 58?	☐ Not Applicable	☐	6.18.4.3
4B	Lock-in-Place devices	Are Lock-in-Place devices provided to prevent unauthorized use or operation of any container appurtenance, system valves, or equipment in lieu of the fence requirements above?	☐ Not Applicable	☐	6.18.4.2 (C)

Note: Fill only items 1, 2, 3, and 4A or 4B. Indicate with "NA" when not filling the "Yes" or "No" column.

‡ Indicate with "NA" if the facility is not operated at night.

Form 6.2
Assessment of Sources of Ignition and Adjacent Combustible Materials

A	B	C	D	E
#	Sources of Ignition and Requirements Pertaining to Adjacent Combustible Materials	Is the Facility compliant?		NFPA 58 Section Reference (2011 Edition)
		Yes	No	
1	Are combustible materials, weeds and tall grass not closer than 10 ft. from each container?	☒	☐	6.4.5.2
2	Is a distance at least 20 ft. provided between containers and tanks containing flammable liquids with flash point less than 200 °F (ex., gasoline, diesel)?	☒	☐	6.4.5.5
3	Are electrical equipment and wiring installed per Code requirements?	☒	☐	6.22.2
4	Is open flame equipment located and used according to Code?	☒	☐	6.22.3.1
5	Are ignition control procedures and requirements during liquid transfer operations complied with.?	☒	☐	7.2.3.2
6	Is an approved, portable, dry chemical fire extinguisher of minimum capacity 18 Lbs. and having a B:C rating provided in the facility?	☒	☐	6.25.4.2
7	Is an approved, portable, dry chemical fire extinguisher of minimum capacity 18 Lbs. and having a B:C rating provided on each truck or trailer used to transport portable containers?	☒	☐	9.4.7
8	Is the prohibition on smoking within the facility premises strictly enforced?	☒	☐	7.2.3.2 (B) & 9.4.10

Note: Insert "NA" in both "Yes" and "No" columns of any items that are not applicable.

Form 6.3

Separation Distances from Containers to Buildings, Property Lines that can be Built upon, Inter-container Distances, and Aboveground Flammable or Combustible Storage Tanks

A	B	C	D	E	F	G
#	Container Size Range in gal (W.C.)	Separation between a property line, important building or other property and the nearest container which is	Minimum Distance (ft)	Is the Facility compliant? Yes	Is the Facility compliant? No	NFPA 58 Section Reference (2011 Edition)
1	501 through 2,000	Above Ground	25	☒ Not Applicable	☐	6.3.1 and Table 6.3.1
		Underground or Mounded	10	☒ Not Applicable	☐	
		Between containers	3	☒ Not Applicable	☐	
2	2,001 through 30,000	Above Ground	50	☒ Not Applicable	☐	
		Underground or Mounded	50	☒ Not Applicable	☐	
		Between containers	5	☒ Not Applicable	☐	
3	30,001 through 70,000	Above Ground	75	☒ Not Applicable	☐	
		Underground or Mounded	50	☒ Not Applicable	☐	
		Between containers	¼ sum of diameters of adjacent containers	☒ Not Applicable	☐	
4	70,001 through 90,000	Above Ground	100	☒	☐	
		Underground or Mounded	50	☒ Not Applicable	☐	
		Between containers	¼ sum of diameters of adjacent containers	☒	☐	
5	All sizes greater than 125 gal	Separation distance between a LP-Gas container and an above ground storage tank containing flammable or combustible liquids of flash points below 200 °F.	20	☒	☐	6.4.5.5 and 6.4.5.6

Note: If any of the container sizes indicated in the above form are not present in the facility, enter "NA" in both Yes and No columns.

If the LP-Gas plant is provided with every one of the redundant and fail-safe product control-design equipment indicated in Form 5.8, then the minimum distance in column D of Form 6.3 can be reduced to 10 feet for underground and mounded containers of water capacity 2,001 gal to 30,000 gal.

Form 6.4
Separation Distances between Points of Transfer and other Exposures

A	B		C	D	E	F	G
#	Type of Exposure within or outside the facility boundary		Check if exposure is present	Minimum Distance (ft)	Is the Facility compliant? Yes	Is the Facility compliant? No	NFPA 58 Section Reference (2011 Edition)
1	Buildings, mobile homes, recreational vehicles, and modular homes with at least 1-hour fire-rated walls		☐	10	☐	☐	Section 6.5.3 Table 6.5.3
2	Buildings with other than at least 1-hour fire-rated walls		☒	25	☒	☐	
3	Building wall openings or pits at or below the level of the point of transfer		☐	25	☐	☐	
4	Line of adjoining property that can be built upon		☒	25	☒	☐	
5	Outdoor places of public assembly, including school yards, athletic fields, and playgrounds		☒	50	☒	☐	
6	Public ways, including public streets, highways, thoroughfares, and sidewalks	From points of transfer in LP-Gas dispensing stations and at vehicle fuel dispensers.	☐	10	☐	☐	
		From other points of transfer	☒	25	☒	☐	
7	Driveways		☒	5	☒	☐	
8	Mainline railroad track centerlines		☒	25	☒	☐	
9	Containers other than those being filled		☐	10	☐	☐	
10	Flammable and Class II combustible liquid dispensers and aboveground and underground containers		☒	20	☒	☐	
11	Flammable and Class II combustible liquid dispensers and the fill connections of LPG containers		☐	10	☐	☐	
12	LP-Gas dispensing device located close to a Class I liquid dispensing device.		☐	10	☐	☐	6.24.4.3

NOTE: Place a checkmark in column C against an exposure that is present in or around the facility. Fill columns E or F for only those rows for which there is a checkmark in column C.

If the facility contains low emission transfer equipment (i.e, all equipment identified in Form 5.9 are installed and are in working order), then the minimum separation distances in column D of Form 6.4 can be reduced to one half of the indicated values.

If the containers in the LP-Gas facility are provided with SPECIAL PROTECTION MEASURES, then continue the analysis below. Otherwise skip Forms 6.5 and 6.6 and go to Form 6.7. Also see Chapter 9.

Form 6.7
Protection Against Vehicular Impact

#	System Protected	Is physical protection provided?		Type of physical protection installed
		Yes	No	
1	Storage containers	☒	☐	Bollards, Guardrails
2	Transfer stations	☒	☐	Bollards, Guardrials
3	Entryway into plant	☒	☐	Fence, bollards

Table 7.1
Distances to Various Types of Propane Hazards Under Different Release Models**

Model #	Details of the Propane Release Model Releases from or due to		Vapor Dispersion Distance to LFL (ft)	Explosion Hazard Distance (ft)	Fire Ball Radiation Distance (ft)
1A	Bobtail hose failure. Release of the entire inventory in the hose, quickly.	1" ID x 150 ft hose length	250	110	50
1B		1" ID x 120 ft hose length	230	103	45
1C		1" ID x 75 ft hose length	190	90	40
2a	Release of the inventory in a transfer piping 1" x 30 ft + @ 20 gpm for 10 min., due to failed excess flow valve.		135	120	25
2b	Release of the inventory in a transfer piping 2" x 30 ft + @80 gpm for 10 mins.		230	252	48
2c	Release of the inventory in a transfer piping 2" x 80 ft. @ 70 gpm for 10 mins.		328	235	74
2d	Release of the inventory in a transfer piping 2.5" x 30 ft @80 gpm for 10 mins.		269	252	59
2e	Release of the inventory in a transfer piping 3" x 30 ft + @100 gpm for 10 mins.		312	287	69
2f	Release of the inventory in a transfer piping 3" x 18 ft + @100 gpm for 10 mins.		256	284	55
3	Release from the container pressure relief valve		No ignitable vapor concentration at ground level		
4	Release from a 1" ID x 150 ft transfer piping to a vaporizer and reduced flow from a partially open excess flow valve @ 20 gpm for 10 min.		250	120	50
5	Leak from a corrosion hole in a transfer pipe at a back pressure of 130 psig (corresponding to 80 °F) for 60 min. Hole size is ¼" ID.		110	120	5
6	Release of the entire inventory in a 2" ID x 20 ft., transfer hose.		195	90	40
6a	Release of the entire inventory in a 2.5 inch dia. transfer hose x 16 ft. length		215	98	45
6b	Release of the entire inventory in a 3-inch dia. transfer hose x 12 ft. length		230	100	46
7	Transport hose blow down: Hose size 2" ID, 20 ft length release for 3min., from a Transport after the tank is filled.		25	30	<5
7a	Transport hose blow down: Hose size 2.5" ID, 16 ft length release for 3min., from a Transport after the tank is filled.		25	29	<5
7b	Transport hose blow down: Hose size 3" ID, 16 ft length release for 3min., from a Transport after the tank is filled.		31	36	<5

** Results from models described in Appendix B. The results are rounded to the nearest 5 feet.

Form 7.1
Types of Occupancies[1] Near or Surrounding the LP-Gas Facility

Type of Occupancies	Model # from Table 7.1	Hazard Distance[2] (feet)	Is Occupancy located within the hazard distance from the Facility?	
			Yes	No
Assembly Occupancies (Places of worship, Libraries, Theaters and Auditoriums, Food or Drink Bars, Sports Stadiums, Amusement Parks, Transportation Centers, etc. with 50 or more people).	2e	771		X
Institutional Occupancies (Elderly Persons Home or Nursing Home, Hospitals, Alcohol & Drug Rehabilitation Centers, Prisons)	0	N/A		
Educational Occupancies (Elementary Schools, Day Care facilities, etc).	2e	1,470		X

NOTES: (1) Different types of occupancies are defined in NFPA 5000

(2) Table 7.1 provides a number of scenarios that can result in propane release, and the resulting area exposed for different ignition mechanisms. Determine the scenarios that are applicable to the facility, for the quantities that can be released, and enter the greatest value from Table 7.1. Use the hose diameters and length that will be used at the facility if they differ from the ones in Table 7.1 and recalculate the hazard distances using a spreadsheet method that is available at npga.org. Some scenarios may not be applicable to an installation because of other mitigation measures implemented, such as a hose management procedure to minimize the possibility of hose failure.

Form 7.2
Exposure to LP-Gas Facility from External Hazards

A	B	C	D
Item #	Type of Neighboring Operation	Hazard exists to the LP-Gas Facility	
		Yes	No
1	Petroleum and other hazardous material storage, wholesale dispensing, etc.	☐	☒
2	Metal cutting, welding , and metal fabrication	☐	☒
3	Industrial Manufacturing that can pose external hazards	☐	☒
4	Ports, rail yards and trans-shipment terminals handling flammable and explosive materials.	☒	☐
5	Other operations that may pose hazards (gasoline and other hazardous material dispensing stations, fertilizer storage, etc).	☐	☒

NOTE: If a particular activity indicated in column B does not exist, fill both "Yes" and "No" columns with "NA."

Where a "Yes" has been checked in either Form 7.1 or Form 7.2:

1) For an existing facility, communicate this information to local emergency responders for inclusion in their emergency planning.
2) For a proposed facility, implement the actions indicated in Chapter 9.

Form 8.2

Response Time data for the Fire Departments

A	B	C	D	E
Company or Department	Time in Minutes for			
	Alarm Receipt & Handling	Turnout	Travel	Total Time
Grafton Fire Department	1	6	3	10
Shrewsbury Fire Department	1	4	2	7
				0
				0
				0
				0
				0
				0

Note: Number in Column E = Sum of numbers from Columns B through D.

Form 8.1
Data on the Responding Fire Department

A	B		C
Item #	**Data Item**		**Data Entry**
1	Name of the Fire Department (FD).		Grafton Fire Department
2A	Name of the person in the FD assisting with the data acquisition.		Chief Mickey Gauthier
2B	Position of the person in the FD assisting with the data acquisition.		Fire Chief
3A	Date on which FD data was collected.		8/9/12
3B	Name of the person collecting the data.		Thomas Godfrey
4	Number of firefighters on duty at any time.		Call Department - 75 80 Members
5	Average number of firefighters available for response.		6 to 46
6A	Number of firefighters qualified to	"Firefighter I" level.	25
6B		"Firefighter II" level.	25
7A	Number of firefighters who would:	Respond on the first alarm to the facility.	Varies. 15-20 depending on proximity of call firefighters and time of day.
7B		Respond on the first alarm and who are qualified to the operations level requirements of NFPA 472 or similar local requirements	Varies. 2-12 depending on proximity of call firefighters and time of day.
7C		Respond on the first alarm with specific knowledge and training on the properties of LP-Gas and LP-Gas fires.	Approximately 1/2 of fire fighters have been trained on LP.
8A	Number of fire apparatus that have the capability to deploy a 125 gpm hose line supplied by onboard water for at least 4 minutes, and, which:	Are in service in the department.	6
8B		Would respond on a first alarm.	3 Engines and 1 Tower.

Form 8.1
Data on the Responding Fire Department

A	B		C
Item #	**Data Item**		Data Entry
1	Name of the Fire Department (FD).		Shrewsbury Fire Department
2A	Name of the person in the FD assisting with the data acquisition.		Chief Vuona (508) 841-8544 jvuona@th.ci.shrewsbury.ma.us
2B	Position of the person in the FD assisting with the data acquisition.		Fire Chief
3A	Date on which FD data was collected.		Oct 25th, 2012
3B	Name of the person collecting the data.		Thomas Godfrey
4	Number of firefighters on duty at any time.		2 at CenTech substation 24/7- Many more at main fire station.
5	Average number of firefighters available for response.		7-24/7
6A	Number of firefighters qualified to	"Firefighter I" level.	7
6B		"Firefighter II" level.	7
7A	Number of firefighters who would:	Respond on the first alarm to the facility.	7
7B		Respond on the first alarm and who are qualified to the operations level requirements of NFPA 472 or similar local requirements	7
7C		Respond on the first alarm with specific knowledge and training on the properties of LP-Gas and LP-Gas fires.	7
8A	Number of fire apparatus that have the capability to deploy a 125 gpm hose line supplied by onboard water for at least 4 minutes, and, which:	Are in service in the department.	6 - (1 at CenTech Station)
8B		Would respond on a first alarm.	3 (One from each station)

Form 8.3
Water Flow Rate and Total Water Volume Required to Cool Containers Exposed to a Fire

A	B	C	D	E	F	G	H
Item #	ASME Container Size (gallons)	Total Surface Area of each Container[1] (ft^2)	Surface Area of each container to be Cooled (ft2)	Water flow rate required per container (gpm)	Number of containers of the size indicated‡	Total Water flow rate required (gpm)	Total volume of water required for 10 min (gal)
1	500	86	43	10.8	0	0	
	1,000	172	86	21.5	0	0	
	2,000	290	145	36.3	0	0	
	4,000	374	187	46.8	0	0	
	6,500	570	285	71.3	0	0	
	9,200	790	395	98.8	0	0	
	12,000	990	495	123.8	0	0	
	18,000	1,160	580	145	0	0	
	30,000	1,610	805	201.3	0	0	
	45,000	2,366	1,183	295.8	0	0	
	60,000	3,090	1,545	386.3	0	0	
	90,000	4,600	2,300	575	0	0	
	80,000	4,098	2,049	512	3	1536	
2a	Calculated water flow rate for container protection					1536	
2b	Water flow rate rounded up to nearest multiple of 125					1625	
3	Water for firefighter protection, if required					250	
4	Total water flow rate and volume					1875	18750

Note: Column D = (1/2) x Column C Column E = 0.25 (gpm/ft^2) x Column D ;
Column G = Column F x Column E Column H = 10 x Column G
Line 2a, Column G and Column H are the sum of numbers in each row above line 2 of each column.
Line 4, Column G and Column H are the sum of numbers in rows 2b and 3.

‡ Consider only 3 containers for water supply evaluations even if the number of containers in a group is more than 3. See Section 8.2.

1 ASME container approximate dimensions

The total water requirement for the facility is indicated in item 4, column G (water flow rate) and column H (total water volume or quantity) of Form 8.3. If multiple groups of containers are present in the facility, repeat the calculations in Form 8.3 for each group of containers. The total water requirement for the facility is the largest value for any single group of containers.

Form 8.4
Evaluation of Water Availability in or Near the LP-Gas Facility

A	B	C	D		
Item #	Water from...	Available?	Quantitative information		
1	Public supply or from another piped-in supply through one or more fire hydrants in or near the facility	☒ Yes ☐ No	Hydrant data	Distance from Container(s) on which water will be applied (feet)	Available water flow rate from all hydrants(1) (gpm)
			Hydrant 1	600	1564
			Hydrant 2	445	
			Hydrant 3	0	
2	A nearby static water source (stream, pond, lake, etc).	☒ Yes ☐ No	Distance to water source = 690 feet Time to set up relay = 10 min. Rate of delivery = 500 gpm		
3	Only through mobile water tanker shuttle.	☒ Yes ☐ No	Time to set up shuttle = 10 min. Sustainable flow rate = 500 gpm		

(1) Obtain the available flow rate from the local municipal water authority or the entity that supplies water to the hydrant or conduct a test to determine total available flow rate.

1. **For an exiting facility, communicate this information to local responders for inclusion in their emergency planning.**
2. **For a proposed new facility, refer to Chapter 9**

Form 9.1
Analysis Summary on Product Control and Local Conditions of Hazard

A	B	C	D	E
Item #	CHAPTER Title	Section & Title	Reference FORM #	Number of "No" checked
1	Product Control Measures in Containers & Transfer Piping	5.1: Product Control in Containers	5.1 or 5.2 or 5.3 or 5.4§	0
		5.2 Product Control in Transfer Piping	5.5	0
			5.6	0
			5.7	0
			5.8	0
			5.9	0
2	Analysis of Local Conditions of Hazard	6.1 Physical Protection Measures	6.1	0
		6.2 Ignition Source Control	6.2	0
		6.3.1 Separation distances; Container and outside exposures	6.3	0
		6.3.2 Separation distances; Transfer points and outside exposures	6.4	0
		6.4 Special Protection Measures	6.5	0
			6.6	0

§ The number of "No" for Forms from Chapter 5 is the difference between the required number of appurtenances according to NFPA 58-2011, and a lesser number found to be actually installed on the container or the transfer piping.

If, in any row of column E ("No") of Form 9.1, the entry number is greater than zero, the proposed LP-Gas facility is not in compliance with the requirements of NFPA 58-2011 for product control appurtenances or other safety measures. The design of the proposed facility must be modified to conform to the code requirements. In addition, the following items should be noted.

- If there are any "No" checks in Form 6.3, then the separation distance requirements for containers are not satisfied. An option that may be considered is the reduction in separation distance to 10 feet for underground and mounded containers by providing "Redundant and Fail-Safe Product Control Measures." In this case, complete Form 9.4 below to ensure that each requirement of "Redundant and Fail-Safe Product Control Measures" is provided.

- If there are any "No" checks in Form 6.4, then the separation distance requirements for transfer points are not satisfied. In this case, relocate the transfer points so that the separation distances conform to the code requirements or provide the Low Emission Transfer Equipment. Complete Form 9.5 below and ensure that all requirements for Low Emission Transfer Equipment are fulfilled.

Form 9.2
Analysis Summary on Exposure from and to the LP-Gas Facility

A	B	C	D	E
Item #	**CHAPTER Title**	**Section & Title**	**Reference FORM #**	**Number of "Yes" checked**
1	Exposure to and from Other Properties	7.1 Exposure to off-site properties and persons from in-plant propane releases	7.1	0
		7.2 Exposure to propane facility from external events.	7.2	1

If the entry number in column E ("Yes"), Form 9.2 corresponding to Form 7.1 is greater than zero, consider one or more of the following design alternatives.

1 Consider moving the container or the transfer point to a different location, if possible and space exists, so that the property or the person is beyond the hazard distance.
2 Provide "Redundant and Fail-safe Product Control Measures". Complete Form 9.4 to ensure compliance.
3 Institute other technical measures such as installing gas and flame detectors (connected to facility shut down systems), sounding alarm outside facility premises, etc.
4 Institute administrative controls such as additional training for personnel, more frequent inspections of hoses and transfer piping, etc.

If the entry number in column E ("Yes"), Form 9.2 corresponding to Form 7.2 is greater than zero, consider one or more of the following design alternatives.

1 Implement procedures to monitor neighboring activity.
2 Install means in the adjacent plant to shut down the LP-Gas plant in case of an emergency in that plant.

Form 9.3
Analysis Summary on Fire Department Evaluations

A	B	C	D	E	F
Item #	CHAPTER Title	Section & Title	Reference FORM #	Number "zeros" entered in Column C, Lines 6 through 8 of Form 8.1	Number of "Yes" checked in Column C of Form 8.4
1	Fire department capability, adequacy of water supply and Emergency Planning	8.1 Data on the Fire Department	8.1	0	
2		8.2 Fire response water needs and availability	8.4		3

If the entry number in row 1, Column E of Form 9.3 is greater than zero, consider one or more of the following design alternatives.

1 Discuss with the local Fire Department the needs of the LP-Gas facility and the evaluation results on the capability and training inadequacies of the Department.

2 Consider developing a cadre of personnel within the LP-Gas facility to respond to emergencies.

3 Institute container special protection system based on active protection approaches or passive approaches. Complete Form 9.6 and Form 9.7 below.

If the entry number in row 2, Column F of Form 9.3 is equal to zero, consider one or more of the following design alternatives.

1 Provide special protection (other than water spray or monitor systems) to containers, satisfying the requirements of section 6.25.5 of NFPA 58, 2011 edition. Complete Form 9.6 to ensure compliance.

Consider implementing the various options indicated in Table 9.1.

Form 9.4
Redundant and Fail-Safe Design for Containers

A	B		C	D	E	F
Item #	Description		Features	Proposed for the facility?		NFPA 58 Section Reference (2011 Edition)
				Yes	No	
1	Container sizes for which the appurtenances are provided		Appurtenances and redundant fail-safe equipment and low emission transfer lines are provided for each container of water capacity 2,001 gal to 30,000 gal	☐ Not Applicable	☐	6.26.3,6.26.4 and 6.26.5
2	Liquid or vapor withdrawal (1-1/4 in. or larger)		Internal valve with internal excess-flow valve	☒	☐	6.26.3.1 and 6.26.3.2
			Positive shutoff valve installed as close as possible to the internal valve	☒	☐	6.26.3.4
3	Liquid or vapor inlet		Internal valve with internal excess flow valve or Backflow check valve	☒	☐	6.26.3.5
			Positive shutoff valve installed as close as possible to the internal valve or the Backflow check valve	☒	☐	6.26.3.5
4	Railcar transfer	Flow into or out of railroad tank car	Emergency shutoff valve installed in the transfer hose or the swivel-type piping at the tank car end.	☒	☐	6.18.2.6 (1) and 6.26.4.1
		Flow only into railroad tank car	Emergency shutoff valve or backflow check valve installed in the transfer hose or the swivel-type piping at the tank car end.	☒	☐	6.18.2.6 (2) and 6.26.4.1
5	Cargo tank transfer		Protection provided in accordance with 6.26.4.1	☒	☐	6.26.4.1
6	Automatic closure of all primary valves (IV & ESV) in an emergency		By thermal (fire) actuation	☒	☐	6.26.4.2
			Actuated by a hose pull-away due to vehicle motion	☒	☐	6.26.4.2
7	Manually operated remote shutdown of IV and ESV		Remote shutdown station within 15 ft of the point of transfer?	☒	☐	6.26.4.3 (A)
			Another remote shutdown station between 25 ft and 100 ft of the transfer point?	☒	☐	6.26.4.3 (B)
			Shutdown stations will shut down electrical power supply, if any, to the transfer equipment and primary valves?	☒	☐	6.26.4.3
			Signs complying with the requirements of 6.24.4.3 (C) provided?	☒	☐	6.26.4.3 (C)

Note: If your facility does not have a rail terminal, write the word NA in both the "Yes" column and the "No" column in item 4 of the form in the railroad tank car row. Similar option is also available if there is no cargo tank vehicle transfer station.

Form 9.5
Evaluation of Low Emission Transfer Equipment

A	B	C		D	E	F
Item #	Description	Features		Proposed for the facility?		NFPA 58 Section Reference (2011 Edition)
				Yes	No	
1	Transfer into permanently mounted ASME containers on vehicles	Delivery nozzle and filler valve-Max. liquid release after transfer of 4 cc.	Fixed maximum liquid level gage not used during transfer operations	☐ Not Applicable	☐	6.26.5.1 (B)
2	Transfer into stationary ASME containers delivery valve and nozzle combination	During product transfer or post transfer uncoupling of the hose, liquid product volume released to the atmosphere	Does not exceed 4 cc (0.24 in^3) from a hose of nominal size 1 in or smaller	☐ Not Applicable	☐	6.26.5.2 (A)
			Does not exceed 15 cc (0.91 in^3) from a hose of nominal size larger than 1 in.	☐ Not Applicable	☐	6.26.5.2 (B)
3	Transfer into stationary ASME containers maximum filling limit	Do containers less than 2,001 gal (w.c.) have an overfilling prevention device or another approved device?		☐ Not Applicable	☐	6.26.5.2 (F)
		Do containers greater than 2,000 gal (w.c.) have a float gage or other non-venting device?		☒	☐	6.26.5.2 (E)
4	Transfer into stationary ASME containers fixed maximum liquid level gage	Not used during routine transfer operations but may be used in calibrating other non-venting liquid level gauges in the container		☒	☐	6.26.5.2 (C,D)

Note: If the facility does not have a particular feature described in items 2 or 3, write "NA" in both the "Yes" and "No" columns corresponding to its row.

Equivalent Protection to a Water Supply for Industrial and Bulk Facilities

In the case where water supply is not available in or near the LP-Gas facility, or is inadequate or it is prohibitively expensive to connect to a public or private water supply hydrant, alternative methods for providing protection should be considered. In lieu of providing a water supply, several alternatives are indicated in Table 9.1, which can offer an equivalency to a water supply system.

The intent of the controls identified in Table 9.1 is to maintain the entire system as a gas tight entity. These methods include reducing the service life of equipment, increasing the design pressure rating of the system beyond the requirements of NFPA 58, or providing early detection and isolation of the system to ensure product control. This list is not exhaustive and is not ranked in an order of priority.

Table 9.1
Suggested Alternative Methods for Industrial and Bulk Plants That Do Not Pose a Hazard But Lack a Water Supply

Item #	Possible options to implement when adequate water supply is not available
1	Reduce the service life of hoses.
2	Increase frequency of equipment inspection.
3	Establish a service life program for the maintenance of the container pressure relief devices. This could include the installation of a listed multiple port valve and certifying that the relief devices are properly set and maintained every 5 to 10 years.
4	Increase the design strength of the piping and fitting systems.
5	Install emergency shutoff valves in conjunction with container internal valves.
6	Install emergency shutoff valves downstream of transfer pump outlets and upstream of the vapor and liquid valves at the bulkhead.
7	Install pneumatic tubing along the facility boundary to serve as a perimeter fire detection system. This would provide protection of the facility against exposure fires.
8	Provide optical flame detection or linear heat detection, or a gas detection system connected to an isolation valve installed downstream of every liquid and vapor nozzle on the container. This system could also be monitored to send a signal to an alarm company that notifies the fire department of an event.
9	Increase the separation distances of internal facility exposures to the container. These exposures would include a site dumpster, idle or waste pallets and combustibles, and increasing the parking distances between the bobtails and transports in relation to the container.
10	Relocate overhead power lines away from all container and cylinder storage areas to protect against ignition in the event of a line dropping due to wind or power pole impact.
11	Eliminate all combustible vegetation within 30 feet of the LP-Gas container. This can be accomplished using gravel, or paving the site yard.
12	Install tanks using the mounding or burial method.